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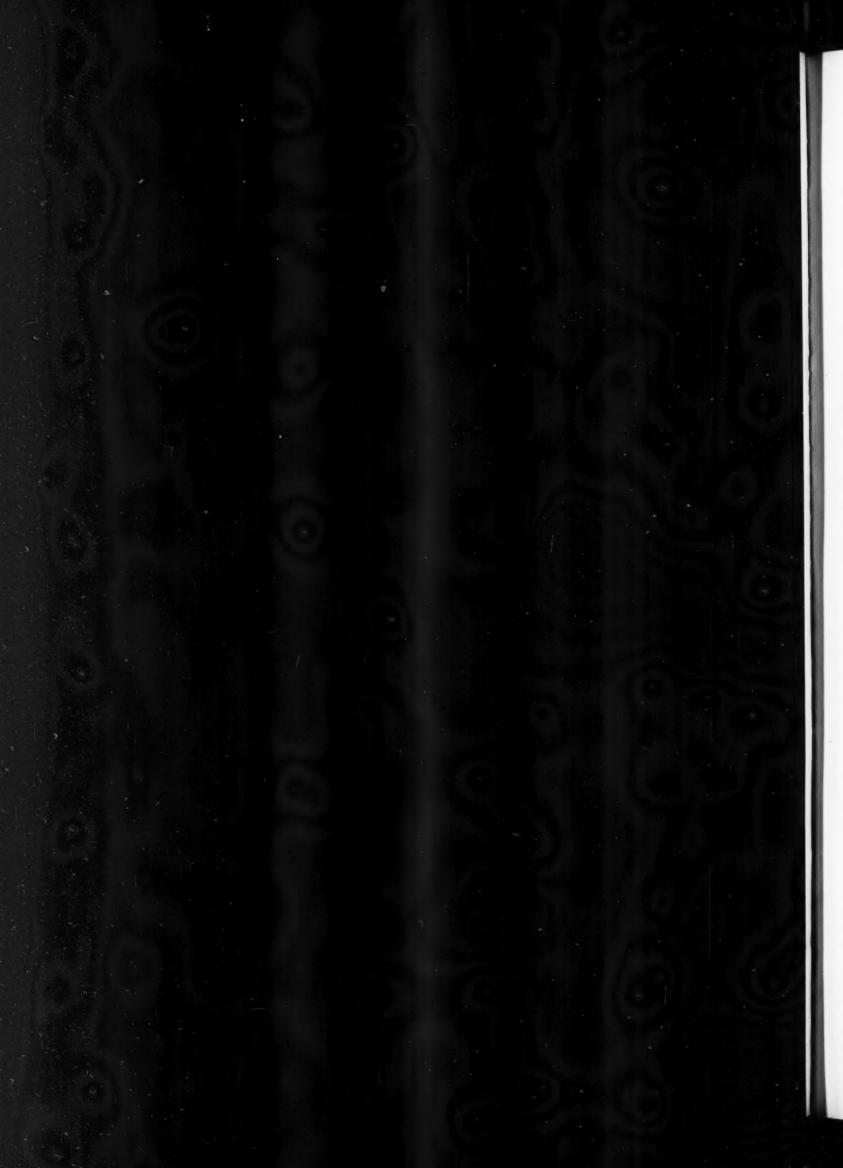


# Austin-Western ROAD MACHINERY

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CITY

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No. 1

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#### With Our Contributors:

A. G. Bruce, author of our leading article, is assistant director of the Division of Design, Bureau of Public Roads. In the old days before the war, he was with the New York State Highway Department. His articles show why he is one of our most valued contributors. . . . The same is true of H. Burdett Cleveland, who presents his excellent review of sanitary engineering progress during the past year. The popularity and value of this article which continues the series published by us during past years is illustrated by the fact that we are still receiving requests for last year's review. Mr. Cleveland is a consulting sanitary engineer, formerly of the New York State Division of Sanitary Engineering. . . . Edmund John-stone, chief engineer of Colprovia Roads, Inc., was a sailor during the World War, and commanded a destroyer in the battle of Jutland. . . . George J. Fertig, who writes on slag roads, lives down in Birmingham, celebrated in many magazine articles. . . . C. R. Spencer, city engineer of Zanesville, O., gives some valuable details of catch-basin construction. J. F. Laboon is a member of the firm of J. N. Chester Co., engineers. His article should be of real value to those engaged in sewage treatment. . . . P. K. Schuy-ler, now president of the Federal Bridge Co., used to be with the Bureau of Public Roads. . . . More about the Akron airport by E. A. Kemmler and A. R. Barbiers of the Akron City Engineering Department. . . . E. B. Johnson of Monroe, La., tells of some paving work down in the land of cotton, oil, and sunshine. . . . F. M. Reast, of the Westinghouse Co., discusses the recurring question of highway lighting.

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No. 1



LOW-COST ROAD IN NORTH CAROLINA, BETWEEN WILMINGTON AND JACKSONVILLE

### Materials and Methods for Low-Cost Roads

By A. G. Bruce\*

Concise presentation of present theory and practice relative to designing and constructing such roads, including location, drainage and soil classification. Natural subgrade treatment; traffic-bound, roller-bound and oil-treated aggregates; mixed-in-place and plant-mixed bituminous treatments; single and double bituminous surface treatments.

The subject of low-cost roads is just now a live topic of discussion at all gatherings of highway engineers and research men. It has become apparent to everyone connected with highway construction that the improvement of our roads is progressing altogether too slowly, and even with the vast sums of money spent annually during the past ten years there still remains nearly 2,000,000 miles of unimproved roads, in addition to over 600,000 miles classed as improved but not yet surfaced. About 80,000 unimproved miles and 107,-000 unsurfaced miles of road are on the State highway systems; leaving a balance of about 1,800,000 miles of unimproved roads and about 508,000 miles of improved but unsurfaced roads which are off the State highway systems and are therefore a responsibility of the county or local subdivision.

If the present practice of requiring county contributions for State highway construction is discontinued and the counties are permitted to devote all their re-

sources to the improvement of local roads, prompt betterment in service to the rural population of the country will result.

Any such wholesale highway improvement by counties and towns means the construction of many miles of low-cost roads, and engineers and highway officials must determine what kind of low-cost roads are best suited for their local conditions. Most of the discussions of low-cost roads pertain to the kind of surfacing to be used, and although this is a matter of great importance we must not overlook the preliminary problems of location, grades, alignment, drainage, and soil classification.

#### DESIGNING THE ROAD

In considering the design of low-cost roads, it might be well to separate them into two classes:

1. Those roads which at present and for many years to come will carry only a very limited volume and weight of traffic.

2. Those roads which must have a low-cost sur-

<sup>\*</sup>Senior Highway Engineer, Bureau of Public Works.

facing for the present but which will eventually have sufficient traffic to require a more expensive paving.

On the roads of the first group, the standards of design may be considerably inferior to best present practice. But the location, grade and alignment of the second group should be carefully considered because the present improvement is only the first stage of development, and unless this first stage is wisely designed the initial investment will be mostly wasted and can never be utilized as a proper foundation for the successive stages of improvement.

#### THE FIRST GROUP

Alignment and Grade.—On the roads in group one, grades as steep as 10 per cent and curves as sharp as 100 ft. radius may properly be used. Whenever the topography permits it, gently rolling grades should be used with very little cutting off of knolls or

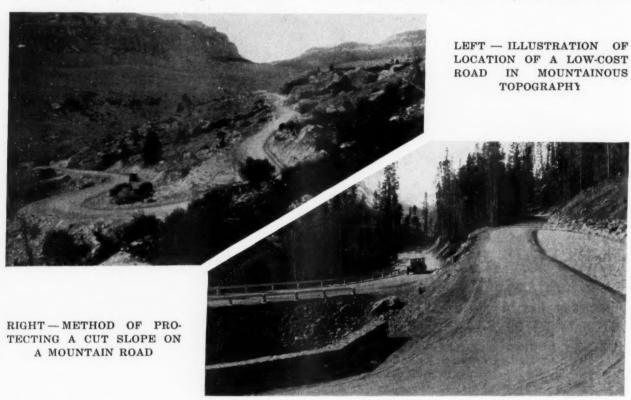
order to avoid locations particularly susceptible to bad drifts and especially drifts that stay late in the spring.

The width of the road will depend somewhat on the nature of the topography, but in general the travel way of the first group need not be more than 12 ft., with 3 ft. shoulders, making 18 ft. from ditch to ditch. The width of roadway should be increased from 2 to 4 ft. on curves, and superelevation should be provided even where no surfacing is to be placed.

Culverts and bridges may be of light construction but should have adequate waterway. In mountainous country, log and square-cut timber bridges can be used to advantage; but in the lowlands, creosoted timber bridges will probably be a cheaper investment.

#### THE SECOND GROUP

Alignment and Grade.—Roads in the second group, that is, those which will later carry considerable traffic.



filling up long hollows. Low-cost road surfacings will not shed water like hard pavements and therefore absolutely level grades should be avoided whenever possible. In hillside locations the contours should in general be followed, but sufficient study should be made to determine the relative cost of cutting through the slopes. Changes in grade should not be too abrupt and should always be rounded off with a vertical curve of sufficient length to give a sight distance of at least 200 ft. Grades of over 5 per cent on sharp curves should be compensated somewhat to facilitate upwardbound traffic and reduce the danger to downwardbound traffic. A reduction in grade of 1 per cent for each 50 ft. in radius shorter than 200 ft. will usually be sufficient compensation. Whenever possible the road should be kept off boggy soil, but locations involving excessive hard rock excavation should be avoided also. In general, in the north, preference should be given to southern and western exposures in hillside locations and snow conditions should be studied in

should be laid out and graded with considerable care. The location should be reasonably direct, but long, straight grades and tangents are not necessary or desirable except in level country. Gently rolling grades should be used, and in general the maximum grade should not exceed 7 per cent; but to avoid sharp curvature, grades as steep as 9 per cent may properly be used. The minimum radius of curves should be 500 ft., except in mountain location, where 100 ft. radius may be used for inside curves and 200 ft. for outside or blind curves. The sight distance at horizontal curves should not be less than 300 ft., and bench cutting or "day lighting" should be resorted to where necessary to obtain proper view.

Vertical curves should be used at all breaks in grade over 1 per cent and sufficient length of vertical curve used to insure a clear sight distance over the hills of at least 350 ft. Grades over 5 per cent on curves of less than 500 ft. radius should be compensated. All curves of less than 1000 ft. radius should be widened

and all curves of less than 2000 ft. radius should be superelevated. At the present time it is customary to use a maximum superelevation of 1 inch per foot of width of roadway for curves up to 1000 ft. radius and about  $\frac{1}{2}$  inch per foot for those of 2000 ft.

Width—On roads in this group a width of roadway of 28 ft. ditch to ditch will ordinarily be sufficient for many years to come. This will permit 18 ft. surfacing with 5 ft. shoulders. The embankment slopes should preferably be as flat as 3 to 1 in order to encourage the growth of grass which will protect the slopes from erosion. The shoulders should be seeded and mowed to protect them from excessive wash due to rain and flood. The cut slopes should be rounded off to permit rapid accumulation of vegetation.

Railroad Crossings.—Relocations to avoid railroad grade crossings should be made whenever feasible. Relocations should also be made to obtain advantageous overpass or underpass sites for railroad grade crossing eliminations.

Guard rail is not so important a consideration in low-cost roads as on main line highways because most of the road users will be familiar with the country and will not need so much protection. At points of unusual danger, however, some form of guard rail should be placed and the availability of local materials will



LOG BRIDGE AND LOG CRIBS

indicate what kind would be most economical. Light wooden guard rail is practically useless as protection and is no longer being built. Solid hub-high wooden guard rail is economical where lumber is plentiful, and in mountain location boulder guard rail makes a very acceptable substitute for the more common types of protection. For general use the cable guard rail has proven a very safe and economical type.

Bridges should preferably have at least a 20-ft. roadway and be designed for at least 15-ton loads. On roads in this group, bridges are a very important part of the improvement and justify a greater cost than present traffic requires. On low-cost roads, creosoted timber bridges with driven pile foundations are usually economical and satisfactory. Bridges should not ordinarily be placed on mud sills, as such construction is seldom stable or economical. As a proper protection against excessive wash, riprap around the bridge abutments should be used.

#### LOW COST ROAD SURFACINGS

The selection of the kind of surfacing for low-cost roads is a problem requiring considerable study and a careful survey of available local materials. Materials which may be used for such work are sand-clay,

top soil, disintegrated granite, scoria, cinders, slag, caliche, marl, chats, soft limestone, shell, pit gravel, crushed gravel and crushed stone.

In addition to these materials, low-cost surfacings may be developed by treatment with calcium chloride and by oil treating or oil processing the natural subgrade. Experiments conducted during the past two years have shown that practically all of the above listed low-cost surfacing materials may be successfully surface treated, but the bitumen to be used and the nature of the treatment will depend on climatic conditions and the availability of supplies.

Classified according to their methods of construction, the usual low-cost surfacings would fall into nine groups:



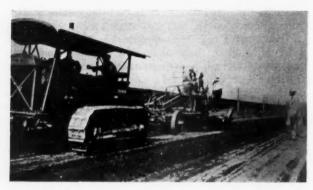
TIMBER TRUSS BRIDGE ON LOG CRIBS, WYOMING

- Group 1-Natural subgrade treatments:
  - (a) Calcium chloride
  - (b) Oil treatments
  - (c) Oil treatments with gravel blotter
  - (d) Oil processing.
- Group 2—Traffic-bound aggregate (untreated):
  - (a) Thin layer method
  - (b) Thick layer method.
- Group 3—Roller-bound aggregate (untreated):
  - (a) Dry rolled
  - (b) Puddled.
- Group 4—Oil treated aggregate (dust palliatives).
- Group 5-Mixed-in-place bituminous treatments:
  - (a) Fuel oil treatments
  - (b) Cut-back treatments
  - (c) Emulsion treatments.
- Group 6—Plant mixed bituminous treatments:
  - (a) Fuel oil
  - (b) Sand asphalt
  - (c) Rock asphalt.
- Group 7—Single bituminous surface treatments.
- Group 8—Double bituminous surface treatments.
- Group 9-Multiple-lift bituminous treatments.

#### GROUP 1-NATURAL SUBGRADE TREATMENTS

Calcium chloride.—The value of calcium chloride as a treatment to earth subgrades lies in its ability to absorb moisture from the air and thereby keep the road surface slightly damp. The road surface is first bladed lightly and an application of calcium chloride is spread with a lime drill or some other type of distributor at the rate of about one pound per square yard. One or two days later the surface is lightly bladed, and during the summer additional light treatments of calcium chloride are spread and the blading operations repeated.

Oil treatments.—The oiling of earth subgrades has not been uniformly successful and dependable data on



OIL PROCESSING SAND SUBGRADE IN NEBRASKA

this method are somewhat meager, but the method has been tried with varying degrees of success in several States. The road is bladed to a true section and compacted by traffic, after which oil is applied hot at the rate of about ¾ of a gallon to 1¼ gallons per square yard. The oil is allowed to penetrate the earth subgrade which is kept smooth by blading. During each succeeding year additional oil at the rate of about ½ gallon per square yard is applied.

Oil treatments with gravel blotter.-This method has been successfully used in the gumbo soil sections of Minnesota and North Dakota. After the road has been graded and allowed to take traffic for some time, the subgrade is bladed smooth and road oil applied at the rate of 1/3 to ½ gallon per square yard at a temperature of 175° to 200° F. This first application is allowed to penetrate into the clay subgrade and is followed by a second application at the rate of about 1/3 gallon per square yard. After this second application of oil has been applied, the gravel blotter (which has previously been placed in windrows along one shoulder) is pulled over the oiled surface with a rubber-tired power blader. The gravel for blotter should all pass a 1/2-inch circular opening and best results have been obtained from applications of 350 to 550 cubic yards per mile. During maintenance, this thin gravel blotter is moved back and forth over the road and during the second year an additional application of oil is made of about 1/4 gallon per square yard and additional gravel blotter applied at the rate of about 150 cubic yards per mile.

Oil processing.—The oil processing of natural subgrades has been used with success on the sandy soils of Long Island, Nebraska, Nevada and California. After the subgrade has been shaped and compacted by traffic, the surface is bladed smooth and the oil applied at the rate of about ½ gallon per square yard. The roadway is then harrowed, a second application of oil applied and the oiled material turned over with a blade grader and windrowed to one side. Additional oil is then applied and cultivated into the subgrade, after which the whole mass is bladed into position and the road opened to traffic. During compaction by traffic the surface is kept smooth by blading.

#### GROUP 2-TRAFFIC-BOUND AGGREGATE

Thin layer method.—The material for this surfacing may be slag, scoria, cinders, gravel or crushed stone. The material should all pass a one-inch circular ring and should contain 10 to 25 per cent of material passing a ¼-inch screen. After the earth subgrade has been shaped and compacted by traffic,

the surfacing material is spread evenly over the road in a thin layer of from  $1\frac{1}{2}$  inches to 3 inches, depending on how many layers are to be placed. This thin layer is opened to traffic and kept smooth by blade grader manipulation until the second layer is placed. The second and succeeding layers are placed and bladed as traffic compacts the surfacing, until eventually a crust of 6 to 8 inches is produced. In some cases only one thin layer is placed the first season and subsequent layers placed as a maintenance operation as traffic requires. This type of road surface is used in Tennessee, Nebraska, Kentucky and Kansas.

Thick layer method.—This is the method commonly used for low-cost road surfaces of sand-clay, top soil, scoria, marl, disintegrated granite, gravel, and crushed stone. The material is spread over the prepared subgrade, either in a trench or feather-edged on the flat grade. Present practice favors the use of material passing a one-inch circular opening and best results are obtained by blader spreading and manipulation. This material is placed in one or two layers of a total thickness of 6 to 12 inches, depending on the nature of the material, the kind of subgrade, and the climate of the locality. Compaction is obtained by traffic, aided by constant blading, and smoothest riding qualities result where a light mulch is kept on the surface.

#### GROUP 3-ROLLER-BOUND AGGREGATE

Dry rolled.—The construction methods for roller-bound surfacings are similar to those given for traffic-bound surfacings, except that a 10-ton road roller is used to compact the subgrade and the surfacing material. The two-course method is preferable where the depth of course is more than 4 inches. In the arid sections of the west the material is rolled dry during construction and rerolled during and after the fall and winter rains.

Puddled aggregate.—This method approaches the old waterbound macadam process except that it may be applied to gravel, slag, cinders and other low-cost materials as well as to broken stone. The aggregate is thoroughly rolled dry in a prepared trench and the voids filled with limestone screenings or other binding material. Water is then added by means of sprinkling carts, additional binder is applied and the rolling continued until a thin grout or puddle is evident on the surface. This type of surfacing is usually placed in two courses, using aggregate from  $2\frac{1}{2}$  inches down to  $3\frac{1}{4}$  inch.

#### GROUP 4—OIL-TREATED AGGREGATE (DUST PALLIATIVES)

This method of treating low-cost road surfacings is not extensively used at the present time and except as a temporary expedient is probably not an economical expenditure of funds. There are instances, however, where the light oil or tar treatment may be used to advantage to keep down the dust prior to some more permanent bituminous treatment or as a winter water-proofing for a newly constructed surfacing. The usual treatment is ½4 to ½ gallon per square yard, and best results are obtained if the treatment is made in two applications about one month apart. The second application is sometimes covered with coarse sand.

#### GROUP 5-MIXED-IN-PLACE BITUMINOUS TREAT-MENTS

Fuel oil treatments.—The western States have developed the light oil processing method and applied it

to many hundred miles of gravel and crushed stone roads with success. The treatment is most successfully applied to well compacted crushed rock surfacing having no particles larger than one inch and having no excess clay content in the binding material. The gravel or crushed stone surfacing is first scarified to a uniform depth of 2 to 3 inches and the oil spread over the road at the rate of about 1/2 gallon per square yard. The oil and aggregate are mixed by means of harrows and another application of oil at the rate of ½ gallon per square yard is applied. This is followed by more harrowing and turning over of the material by blade grader, which moves the oiled mass back and forth across the road until the materials are thoroughly mixed and of uniform color. During this process more oil is added if necessary, and when of satisfactory color, the material is bladed to the desired width and crown and opened to traffic. During compaction by traffic, a blade grader is employed to keep the surface smooth and free of ruts.

Cut-back treatments.—In the Mississippi valley and eastern States, tar and cut-back asphalts are used instead of fuel oil for the processing of sand-clay, gravel and crushed stone roads. The manipulation of the aggregate is generally similar to that described for western oil processing, except that it appears to be more common practice to blade back the first treated layer and apply the second bituminous treatment to the exposed material. This material is then mixed with bitumen and the first treated windrowed material is brought back and the whole mass bladed into position and allowed to set up. In some cases a power roller is used to compact the surfacing; in other cases it is compacted by traffic.

In Indiana it is common practice to use the mixedin-place method for new topping of old gravel and macadam roads. The new layer of stone, from 2 to 3 inches in depth, is placed over the old base and lightly rolled with a power roller. The cut-back asphalt is then spread at the rate of about ½ gallon per square yard and the asphalt and stone mixed by blading. The course is then rolled with a power roller and left for a few days until the lighter oils have evaporated, after which the road is again bladed, rolled and the surface voids filled with stone chips. A second application of asphalt is then applied at the rate of about .2 gallon per square yard and the surface lightly dragged and rolled. After about three weeks, a light seal of cut-back asphalt is applied and the surface sparingly covered with screenings.

Emulsion treatments.—This alternative for fuel oil has been tried in some of the western States. The advantages claimed are quicker set-up due to the rapid evaporation of the water used in the emulsifying process, and the use of a heavy 95 per cent asphaltic oil which gives more stable results than the light fuel oils. The method has not been standardized to the same extent as the fuel oil method, but best results have been obtained by first applying a light fuel oil primer prior to using the emulsified asphalt.

The blading and mixing is similar to the usual processing method except that shorter sections of road must be manipulated or the asphalt will set up before the manipulation is completed. This treatment is usually rolled with a light power roller to remove the marks left by the manipulating equipment and then sealed with a ¼-gallon application of emulsified asphalt and a cover of pea gravel.

GROUP 6-PLANT-MIXED BITUMINOUS TREATMENTS

Fuel oil.—Due to the difficulties of properly mixing the oil and stone by blading on the road, the plantmixed method has proven popular in some of the western States. Standard size aggregate is used, ex-



EFFECTIVE USE OF STONE PARAPET WALL FOR PROTECTION OF TRAFFIC

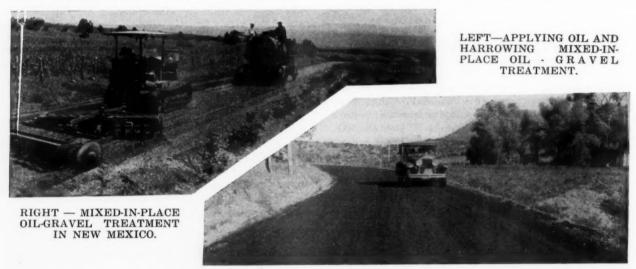
cept that 40 to 60 per cent should be retained on a #3 mesh standard sieve. The crushed material is separated into two sizes and stored in separate bins at the mixing plant. One bin contains a material retained on the #3 mesh sieve, and the other bin the material passing the #3 mesh sieve. The two sizes are recombined in proper proportions and mixed with heated fuel oil in the amount of 3 to 5 per cent by weight of the stone aggregate. Mixing continues until the materials are of uniform color and all the stone particles are thoroughly coated with oil. The mixed material is then transported to the prepared road base and spread by bladers to a true section.

Sand asphalt.—In the sandy sections of North Carolina, Delaware and Massachusetts, this type of road surfacing has been extensively used. After the sandy subgrade has been shaped up, local sand is dried and heated at the plant, measured accurately by weight and mixed with the hot asphalt in a pug mill mixer until a uniformly coated and homogeneous mass is produced. The base course material usually contains from 6 to 9

hot as well as cold applications are practiced. The base to be treated is swept clean with a power broom and a priming application of light oil or tar is spread over the road at the rate of about .2 gallon to the square yard. After this has penetrated into the base, the heavier oil or tar application is spread at the rate of ½ gallon per square yard and immediately covered with a blotter of pea gravel, slag, or rock screenings. The treatment is usually repeated the second year and then at intervals of two or three years. In some States the priming oil application is not used, but there appears to be less separation of the oil mat from the base where this extra precaution is taken.

GROUP 8—DOUBLE-COURSE BITUMINOUS SURFACE TREATMENT

This treatment is similar to the single-course treatment except in the additional applications of oil and aggregate, which usually produces a thicker mat and a more durable and smooth-riding surface. The base to be treated is cleaned with a power broom and a prime coat of tar or asphalt spread over the surface. After



per cent bitumen and is laid in a 3 or 4-inch course. The top course contains 9 to 12 per cent bitumen and is usually laid in a 2-inch course. Both courses are laid with the material at the temperature of about  $300^{\circ}$  F

Natural rock asphalt.—This material is used as a topping on bases of compacted gravel, caliche, lime rock, shell and crushed stone. The prepared base course is first treated with a light priming application of oil or tar and, when tacky, is covered with a thin layer (¼ inch) of finely crushed rock asphalt. After this thin layer has been compacted by traffic or with a roller, the main body of the rock asphalt course is spread and rolled. The material is usually crushed at the mines to the size desired and shipped to the job, where it is fluxed and remixed and usually laid cold on the prepared base. This type of surfacing has been laid in courses ranging from ½ inch to 2 inches, but the usual practice is 1 inch to 1½ inches.

GROUP 7—SINGLE-COURSE BITUMINOUS SURFACE TREATMENTS

This treatment is applicable to any of the low-cost surfacing materials which have been well compacted and are of sufficient depth to adequately support traffic. Both tar and asphalt are used for this treatment, and this has penetrated the base, an application of heavier oil or tar is spread at the rate of .2 to .4 gallon per square yard and immediately covered with stone chips, gravel or slag. The sizes of particles in this blotter vary in different States but are usually not over 1 inch. The first course is usually rolled with a power roller and then a second application of oil or tar is spread at the rate of about .2 gallon per square yard and immediately covered with rock screenings or coarse sand. Either hot or cold tar or asphalt may be used for this treatment, and each locality has developed a bitumen specification suitable for its local conditions.

This method is somewhat similar to those previously described, except that a thicker course is built up by from three to five separate applications of oil and stone. The stone aggregate used for cover is graded from 2-inch size for the first application to ½-inch size for the last application. The first lift consists of oil applied at the rate of .15 gallon per square yard covered with aggregate from 1-inch to 2-inch in size, spread by blade graders at the rate of .05 cubic yard per square yard.

GROUP 9-MULTIPLE-LIFT BITUMINOUS TREATMENTS

This is lightly rolled with a power roller and a second lift made by applying oil at the rate of .75 gallon

per square yard covered with aggregate ½ inch to 1 inch in size, followed, during the rolling and brooming, by aggregate ⅓ inch to ½ inch in size. The larger aggregate is applied at the rate of .01 cubic yard per square yard, and the smaller aggregate at the rate of .005 cubic yard per square yard. The third lift consists of oil applied at the rate of .375 gallon per square yard covered with aggregate ⅙ inch to ½ inch in size at the rate of .015 cubic yard per square yard, followed by sand or fine screenings at the rate of .003 cubic yard per square yard. This type of bituminous treatment has been developed by the Oregon Highway Department.

#### Refuse Disposal In Detroit

Detroit collects annually about 170,000 tons of garbage, which is hauled an average distance of over five miles to the Wabash railroad, by which it is carried to a privately owned reduction plant, the owners of which are paid by the city for disposing of it. The average cost of collecting and disposing of the garbage is now between \$9.00 and \$10.00 per ton.

During the year the city also collects about 2,000,000 cubic yards of rubbish, ashes and street dirt, which it dumps, mostly upon private land for which the owners charge 5c a yard or more for dumping privilege, insisting also that tin cans and automobile bodies be not dumped there. Shears and balers have been installed at transfer points, where automobile bodies are brought by the hundred, cut up and baled and sold to local dealers.

Commissioner of Public Works John W. Reid has asked council to authorize the expenditure of \$250,000 with which to build an incinerator at the east side garbage transfer station, with a view to burning here both garbage and rubbish. This method of disposal is apparently endorsed by the Detroit Bureau of Governmental Research, which (in one of the leaflets which it published about once a week, entitled, "Just a Minute") states that this method of refuse disposal "promises absolute sanitation, a reduction in hauling costs by one-half or more; reduce labor costs in the handling of garbage; reduce collection costs through combined collection of garbage and inflammable rubbish, and the conservation of dump areas for ashes." It states that it has been estimated that such an incinerator will pay for itself in four or five years.

#### Snow Handling In Wyoming

A state highway engineer of Wyoming, Z. E. Sevison, has arranged to keep about 2000 miles of highway open to travel during this winter. The snow removal program includes eight interstate roads. No attempt will be made to keep open many of the mountain highways.

Snow removal equipment was distributed to 20 bases, each of which will have a crew of about 5 men, one high-speed but powerful truck equipped with a snow plow, a low-speed powerful truck, and a crawler tractor and blade plow. The tractor and plow are so constructed that they can be run quickly onto the platform of a truck and rushed to the point where an accumulation of snow has become too deep for the truck to handle.

Roads that are elevated above the general level are kept fairly clear by the wind but snow accumulates in cuts, and to minimize this trouble cuts have been widened to the very edge of the right-of-way instead of merely to the outside of the ditches; also snow fencing is used widely. Snow fences built of snow have proved quite effective, these being constructed by use of a tractor and blade plow. Beginning at a point more than 100 feet from the right-of-way on the side of the road from which the prevailing wind blows, the plow is run through the snow parallel to the road throwing up a ridge, and similar ridges are thus thrown up paralleling each other, up to the edge of the road. Snow drifting before the wind falls into the valleys between these ridges, which must all be filled before any considerable amount can reach the highway. Mr. Sevison says that it is useless to plow snow against the wind, as one blade of a V plow does, and he uses blade plows to throw the snow with the wind; for that which is pushed off the road towards the wind will blow back onto the road again.

They have found that high-speed powerful trucks with blade plows can make 100 miles in a 10-hour day. All the trucks' cabs are heated and well lighted, and are worked day and night until the road is opened, which will not often, if ever, exceed 48 hours.

Many of the bases are placed at the junction of north and south and east and west roads, so that the crews can work whichever of the four roads may be hit by a serious storm; it being only on rare occasions that all four roads will be blocked at the same time. Also the bases are so placed that two crews may work toward each other to open any given stretch.

#### Sewage Treatment Required by Eight States

The health commissioners of the states named below met on October 2, at Minneapolis, and adopted the following resolution:

The Departments of Health of the State of New York, Pennsylvania, Ohio, Indiana, Michigan, Illinois, Wisconsin and Minnesota, signators to the Great Lakes Drainage Basin Sanitation Agreement, hereby agree relative to the treatment of municipal sewage that

- (1) when their advice is sought, or
- (2) when plans of municipal sewage treatment works are submitted for approval, or
- (3) in the issuance of orders or decrees to municipalities relative to the treatment of sewage, the minimum degree of sewage treatment shall be "efficient sedimentation;" provided, however, that nothing herein contained shall be construed to mean that suitable higher degree of treatment may not be required as needed for the protection of public health nor construed as hampering or interfering with the discretion of each State Health Department in details of sewerage projects such as minor sewer outlets, storm water overflows and the like.

#### City Planning in Jacksonville

The city commission of Jacksonville, Fla., on October 3 adopted a city plan prepared by George W. Simons, Jr., and on November 12 it was adopted by the city council. The city planning advisory board representing 21 civic organizations, is urging the carrying out of the plan.



THIS SHOWS QUITE CLEARLY HOW PRESENT LEVEES ARE BEING ENLARGED. THE RIVER IS JUST BEHIND THE WOODS AT THE LEFT. U. S. TOWER MACHINE IN THE DISTANCE.

## What Is Being Done for Flood Control on the Mississippi

A member of the Editorial Staff of Public Works recently returned from another visit to the Mississippi flood control activities. So many inquiries have been received as to "What are they doing down there?" that a brief outline of the work in progress is herewith given.

The plan adopted for Mississippi flood control, on the basis of which work is now going on, provides for a lowering of the flood plane in certain areas by means of floodways, and a raising of levees more or less all along the river. The flood plane at Cairo, where the flood problem really begins, is to be lowered by the setting back of the levees between Birds Point and New Madrid, on the Missouri side of the river. Below New Madrid, and as far down the river as the mouth of the Arkansas, levees are to be raised an average of about 3 feet.

In the middle section of the river, from the Arkansas to the Red, the present plan calls for diversion of some of the flood waters from the Mississippi main channel into the Boeuf river basin, which roughly parallels the Mississippi. In addition, there is to be a moderate raising and strengthening of the levees. Below the Red river, some levee setbacks will be made, but main dependence for safety in times of extreme flood will be placed on the Atchafalaya floodway, which will take approximately half the flow of the Mississippi through a much shorter channel to the Gulf.

As a final safety valve for New Orleans, the Bonnet Carre' spillway, about 25 miles above New Orleans, will divert 250,000 second feet into Lake Pontchartrain. The effect of all these diversions will be to limit the flow past New Orleans to about 1,250,000

second feet, which amount, it is assumed, can be handled without risk.

PRESENT STATUS OF THE WORK

This, in brief, is the plan upon which the work is being prosecuted, despite the objections and the legal and oral obstructions being employed to block it. Whether there are to be modifications or changes, no one knows. Meanwhile, the work is going on.

Levees all along the river have been raised and strengthened, and work is now beginning on the New Madrid floodway, and is under way on the Bonnet Carre spillway. Generally speaking little has been done on the Boeuf and Atchafalaya floodways.

The Northern Section.—In the section of the river between Cairo and the mouth of the Arkansas, the general policies adopted are being carried out. Around Cairo, levees are being raised in order to provide a greater freeboard, and the section is being increased in order to give greater safety against prolonged periods of high water, such as prevailed in 1927 and also in 1929. The 1929 flood lacked only about three feet of reaching the 1927 flood levels, and persisted for a long period of time. The successful resistance offered by the newer levees to this high water indicates that the enlarged levee section can be relied on to withstand the effect of extreme floods.

The New Madrid floodway has been held up by litigation and by protests, but work is now starting on this 21-mile stretch. The principal cause of argument

was the difference of opinion as to land values, and also as to the effectiveness of the floodway and the so-called "fuse-plug" levees. Neither matter has been settled satisfactorily, but on the land value question an adjustment has been made which permits work to go ahead, although it does not satisfy the property owners. There is no agreement whatsoever as to just what results are going to be secured if and when the floodway comes into use.

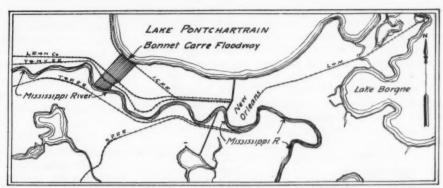
Proponents and opponents, using such different values of n in Kutter's formula as their experiences or desires indicate, secure corresponding values of flow in the floodway and consequently different estimates of the drop at Cairo.

The proponents of the adopted plan set the probable lowering of flood waters at Cairo at 6 feet; some of the opponents of the plan contend that there will be no real lowering, once the "jug," as they call it, fills. Unbiased opinion seems to be that there will be some lowering, but that probably it will not amount to as much as 6 feet. Much will depend upon the condition of the floodway. If farming on this land is continued and the area kept clear, the volume of flow will be greater than if small timber is allowed to spring up, as it does very rapidly in this section.

There is also much uncertainty as to the damage that will be caused by flowage over this area. Many local people express the fear that the land will be ruined. There is some basis for this belief in the sand deposits that have formed in the past at crevasses at many points; but again, only time will tell.

Raising and strengthening of levees is going on along both sides of the river in this section, and with the work on the floodway now actually going on, the northern section of the river, within two or three years, will be in substantial agreement with the plan.

Middle Section.—A considerable amount of work in

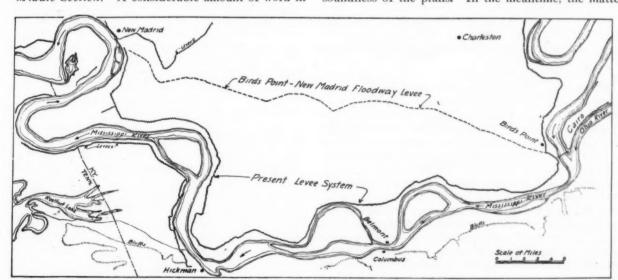


THE BONNET CARRE FLOODWAY IS SOME 20 MILES ABOVE NEW ORLEANS. IT DISCHARGES INTO LAKE PONTCHARTRAIN

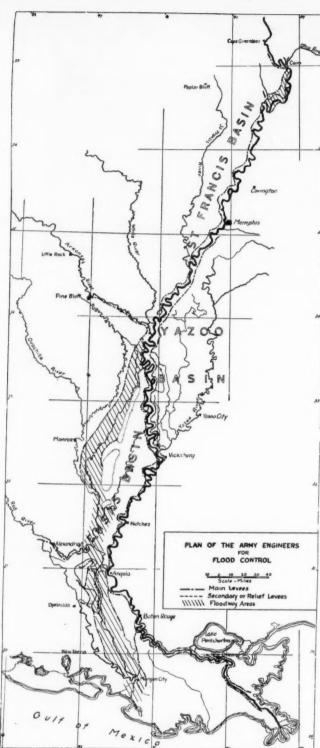
raising and strengthening the levees is going on in this section, something like 3 feet added height being provided and the landside slope of the levee being increased, the amount of slope depending upon the material of which the levee is being built.

No actual construction work has been begun on the Boeuf river basin diversion project. Litigation over land and flowage rights has been the main stumbling block, and no early solution appears to be possible. As in the case of the floodway below Cairo, many arguments have arisen over the adequacy of the Boeuf river diversion. The adopted plan calls for nearly three-quarters of a million second-feet passing down this basin, which flow will be localized to some extent by levees on either side of the Boeuf. Opponents of the plan question the ability of the 15 miles of "fuse-plug" levee to pass this amount, and also the ability of the basin, of which a large part is wooded and swampy, to carry this volume of flow. Again the missing link is the value of n, and this no one knows, though there are a good many opinions regarding it.

Southern Section.—Raising of levees and construction work on the Bonnet Carre' spillway are the main activities in construction in this section. The objection to the use of the Atchafalaya as a gigantic floodway to carry 1,500,000 second-feet are as bitter. Also technical questions are being raised as to the engineering soundness of the plans. In the meantime, the matter



GENERAL VIEW OF THE BIRDS POINT-NEW MADRID FLOODWAY Showing old and new levees. Land between constitutes the floodway.



FROM CAIRO TO THE GULF, THE MISSISSIPPI OFFERS A PROBLEM

is tied up in the courts with no prospect of an early settlement.

Levees are being raised about 3 feet, and the base section increased as is necessary, making due allowance for the type of materials used. The work of putting the Bonnet Carre' spillway into reality is well begun. Like other features of the plan, this spillway is the subject of much controversy. It has been called a "psychological spillway" and assertions have been made that it will never be used. In the meantime, it

appears that certain matters of design are yet unsettled; no apparent provisions have been made in the plans for the two main rail lines which will be crossed by the flood waters. In fact, the operation of the spillway would cut off communication with the city from the north, which might be an important matter.

Neither has any definite plan been made for the main north-and-south highway which now hugs the levees quite closely from New Orleans to Baton Rouge. Two solutions have been offered for this: To let the state highway commission do the worrying, and to carry the road over the floodway on a pile trestle. Doubtless the design of a pile trestle to safely carry a roadway over water 12 or more feet deep running at a velocity anywhere up to 15 or 20 feet a second, considering the rather unstable soil formation at that place, will be difficult.

Another matter which appears to be unsettled here is the amount of flow that the floodway will carry; also there is a question in some quarters as to whether or not the soil will withstand the velocity of flow, and in what direction erosion, if any, will act.

#### OTHER WORK

A point on which there has been much criticism in the past has been the lack of many of the data necessary for studying some of the disputed points mentioned previously. A number of large survey parties are now at work, and in the near future there will be available considerable information of a definite nature regarding topographical features of the areas of country involved.

#### DEVELOPMENT OF CONSTRUCTION METHODS

The increased size of the levees, requiring a greater amount of material for their construction, has presented a dirt-moving problem which has not yet been fully solved. In the lower river, where borrow-pit slopes of 1 on 10 are permitted, large draglines are almost universally accepted as the solution, and have given economical results. In the areas around Vicksburg the borrow-pit slopes are set at 1 on 25 and in the Memphis district 1 on 50. Tower machines, so long a standard method of construction, can now be worked economically only in selected localities. Large drag-lines, industrial railway units, tractor and crawler wagon teams, and hydraulic filling are being tried out; but while each of these methods has been found well suited to certain conditions, none is generally applicable to all. Other methods are being investigated, and doubtless there will be developed in the future some method of dirt handling which will handle satisfactory the usual run of jobs.

#### CONTRACTORS' PROBLEMS

Few of the contractors are making even a fair profit, it appears from a general survey of the work. There are so many factors bearing on this state of affairs that it is difficult to assign any definite reason for it. Contractors are apt to attribute most of their difficulties to the fact that they are often required to bid in competition with the hired labor forces of the United States Engineer Department. This, however, is not the whole story, though it may be a factor of some importance. Other reasons that have a share probably include unfamiliarity with large-scale work of this character, too low bidding in anxiety to get a particular job or to keep busy machinery on which payments must be made, and a degree of incurable optimism. At any rate present prices, especially on the upper

reaches of the river, appear to be too low to yield an adequate profit. This may work itself out, but in the meantime a good many contractors are going to have no difficulties with income tax payments.

The matter of contractors' problems and the different types of equipment now being used on the river will be discussed more fully in a later issue of Public Works

THE MISSISSIPPI RIVER COMMISSION

During the past year considerable strides have been made by the Mississippi River Commission, or, more strictly speaking, the Army Engineers, in organization and personnel. There has been a considerable expansion in personnel, and a decentralization of authority and management which shows itself in a smoother handling of the work and a better grasp of some of the problems. There are a number of extremely able men in Commission service, both civilian and Army engineers; quite notable among these are a number of men recently transferred from the Ohio river improvement, now practically completed.

There has been, and still is, a great deal of criticism of the Commission's engineering forces, most of which appears to be unjustified. For the greater part, the engineers, both civilian and military, and other technical personnel on the river work, are men of ability and earnestness, who are doing a great work in a very

creditable manner.

## Should We Light Our Highways

By F. M. Reast \*

Some of the advantages which adequate illumination of traveled roads will bring to the general public. These include elimination of headlight glare, reduction of traffic congestion by encouraging night use of highways and bringing electric power to the farm. Changes of state laws will be necessary in some states, to permit appropriation of funds for this purpose. Estimates of cost are given.

It is well recognized that the effective illumination of city streets promotes civic prosperity, decreased crime, greater business activity and fewer traffic accidents; and any opposition has quickly subsided when the manifest advantages of the improvement

became apparent.

In many cities and towns, improved street lighting has been installed in the downtown or business districts, but in the residential areas and on secondary thoroughfares lack of interest on the part of the property owners has resulted in a lamentable neglect of street lighting, which in some instances has had very detrimental effects on the districts in question. While the actual planning of lighting for such areas may safely be entrusted to the responsible civic authorities, the cooperation, both moral and financial, of the citizens themselves is necessary if effective results are to be expected.

In highway lighting which, although it presents

\*Westinghouse Electric and Manufacturing Company.

special problems, is simply an extension of the city street lighting into rural districts, the same need for active encouragement and genuine interest on the part of the people is vitally essential. In promoting what is probably the largest installation of this character—that on the White Horse Pike near Atlantic City and Philadelphia—the activity and support of the citizens and business interests of the "World's Playground" played a very important part. In fact, because of the comparative novelty of highway lighting, even greater interest is required to overcome the inertia attendant upon a comparatively unknown and little understood problem.

At the present time, interest in highway lighting appears to be confined to a limited number of motorists who have actualy experienced the satisfaction and comfort of driving at night over an adequately illuminated highway. Because of legal obstacles that will be mentioned later, the number and extent of such lighted highways is greatly restricted at the present time, and it will only be through the efforts of those who realize the manifold advantages of such lighting and the still greater advantages which further extensions of it will produce, that deeper interest will be taken in the matter.

The acquirement of the many miles of good roads which we now enjoy came through the organized efforts of the motoring public. As the number of motorists became greater, and particularly as the farmer began to realize the value of automotive transportation, the demand for better highways made itself felt in the state legislatures, largely through the motor clubs and the good roads organizations.

In a similar way must we look for the development and extension of highway lighting. It is apparent that head lights on automobiles have not effectively met the requirements. The headlight is at best a portable unit which, while eminently satisfactory from the drivers' standpoint in clear weather, is inadequate under foggy or snow conditions and constitutes a positive menace to approaching motorists at all times, and it seems to be a physical impossibility to legislate head-light glare out of existence. All attempts to nullify it by means of focusing laws are futile, for accurate focusing, to be really effective, involves the inflation of the tires, the loading of the vehicle, and minute irregularities in roadways.

In addition to decreasing accidents caused by glaring headlights, adequate illumination of highways will produce many other direct and indirect benefits. Among the former may be mentioned the use of existing roads at night as well as by day, which will decrease congestion to the extent that the present day-

time traffic is diverted to the night hours.

The indirect benefits of lighted highways to both the motorist and the public at large, especially the farmers, are also worthy of consideration. Good roads have benefited the farmer economically in permitting him to bring his produce to market in quicker time; the rapid removal of snow from the principal highways extends this benefit to the entire winter season, and highway lighting will encourage the over-night delivery of milk, eggs and butter, to the ultimate benefit of urban residents.

An equally important benefit is bringing the cost of rural electrification more nearly within the me us of every farmer. At present the financial investment required to bring power lines to many rural districts is prohibitive; but were this to be met by appropriations for highway lighting as well as by income from farmers along the highway, both farmers and the automobiling and produce-consuming public would benefit.

THE LEGAL OBSTACLE

The principal hindrance to the furtherance of highway lighting projects at the present time seems to revolve around the legality of appropriating state or county funds for installing and maintaining the lighting equipment. It appears that county road commissioners, for instance, are not at present legally empowered to allocate any portion of state moneys for purposes other than road construction or repairs. However, this legal impediment has been removed in some states, including New York, New Jersey and Georgia, and the matter is now being considered in Ohio, Massachusetts, Indiana, Wisconsin and other states. Excepting in the case of New Jersey, however, which has authorized the allocating of state funds for the purpose, this legislative action merely legalizes or approves the expenditure of county or township funds for highway lighting.

It is not sufficient, however, for a state to say in effect "Highway lighting is a good thing, go ahead and put it in" and leave the problem of financing to local interests. Highway lighting should be considered as an essential part of the highway, as general in its benefits as the highway surface, and the money for installation and upkeep should come from state or Federal funds. When we consider that highway lighting, to be of the fullest benefit, must be statewide in extent and not restricted to short stretches in scattered territories, the reasonableness of this con-

tention is apparent.

COST OF HIGHWAY LIGHTING

Figures for cost of highway lighting must necessarily be based on estimates, since the existing installations are so small that the utility companies have merely extended to them the prevailing rates for

lighting streets in the neighboring cities.

Customarily, contracts for overhead street lighting by electric utility companies provide that they furnish and maintain the equipment as well as supply the power. It seems logical that this practice should be continued in the case of highway lighting, for the following reasons: First, the utilities are already equipped to render such a service from a physical standpoint; second, such an arrangement permits the unlimited extension of highway lighting in all directions, since there is always a utility company within reach; third, the state, county or other political subdivision is relieved of all responsibility for maintaining or repairing the lines; fourth, the utility company, by obtaining a revenue by furnishing energy to rural customers along the highway, is able to quote a lower rate for highway lighting; fifth, conversely, the rural districts will benefit not only from highway lighting itself, but from the extension of electric service to farms, which its installation will make economically possible; sixth, the exact cost of the project over the contract period is known in advance and suitable funds can be allocated accurately for the purpose.

According to one authority, \$1500 represents the approximate annual cost of highway lighting per

mile, including energy, maintenance and fixed charges on the investment. Because of the slightly higher rates charged for street lighting in the eastern states, the figure would probably run several hundred dollars per year higher there. Another authority estimates the annual cost at \$750 per mile per year, but bases his estimates on 250-c.p. lamps and correspondingly smaller equipment.

The writer believes that 4000-lumen, (400-c.p.) lamps spaced 18 to the mile should be the minimum size considered for a highway lighting project if adequate illumination is to be expected under all conditions. In fact, with the present-day tendency toward higher intensities, 6000-lumen (600-c.p.) lamps would not be an inappropriate size for heavily

traveled highways.

Installation\_Material

The estimates which follow are based on the use of 4000-lumen, 6.6-ampere, series lamps, but no material changes other than those effected by the increased cost of larger lamps and transformer, would be necessary if 6000-lumen lamps were specified.

While these estimates have been carefully compiled, they probably will not apply exactly to all parts of the country, which is true of estimates of constructing the highways themselves. Generally speaking, it will be found that highway lighting represents from two to three per cent of the cost of a mile of paved highway.

#### COST OF HIGHWAY LIGHTING PER MILE

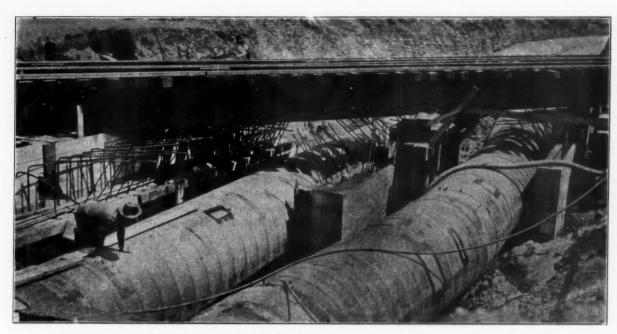
Based on 18 units 300-ft. apart, each equipped with a 4000-lumen series lamp.

Section A

Installation—Material		
1 5 kva transformer	\$280	
1 time switch	75	
18 Hilux units and brackets	860	
11,000 ft. No. 6 wire	316	
500 ft. No. 8 wire	18	
36 wood poles	360	
36 cross arms	50	
72 cross arm braces	5	
150 insulators	60	
Guying	15	
18 4000-lumen lamps	27	
Pole hardware and miscellaneous supplies .	85	
- approx		
		\$2151
0		
Section B		
Installation—Labor		
Wiring and installing units, at \$5.00	\$90	
Labor and material to paint brackets, at 50c	9	
Labor to string wires, at \$4.50	72	
Freight and hauling	125	
Insurance, \$6.70 per \$100	13	
Setting 36 poles, at \$4.00	144	453
M-4-1 (4-1)-41		
Total installation cost		\$2604
Section C		
Operation, Maintenance and Fixed Charges:		
Energy, at \$.02 per kwh	9995	
Lamps, 3/unit/u	\$323	
Maintenance—1% of \$2604		
Inspection and cleaning 100 of 2004	26	
Inspection and cleaning, 1% of \$2604	26	
Depreciation, 10% of \$2604	260	
Interest—6% of \$2604	156	
Taxes—2% of \$2604	52	
Supervision, ½%	13	
A	-	
Annual cost per mile		\$939

#### Kentucky to Buy Toll Bridges

The State Highway Commission of Kentucky has sold 5% bonds to the amount of \$11,657,000 to be used for the purchase and construction of toll bridges, the interest and the principal of which are to be paid by bridge tolls. The engineers of the department have made a traffic survey of each bridge or bridge location and placed upon it an estimate of the future traffic which may be expected.



CARRYING LINES OF 74-INCH STEEL PIPE OF THE WANAQUE AQUEDUCT UNDER RAILROAD

## Water Supply, Sewage Treatment and Refuse Disposal in 1929

Review of the more important developments in the science and art of these branches of public utilities, and important construction undertaken during the year.

#### By H. Burdett Cleveland\*

#### WATER SUPPLY

Management and Control. An important step was taken during the year in the matter of improving financial management of water works. At the summer convention of the American Water Works Association in Toronto, a new division, the Division of Water Works Accounting and Finance, was created in addition to the existing divisions of Water Purification, Plant Management and Operation, and Fire Prevention. Discovery of financial leaks, and helpful interchange of ideas in recording and analyzing income and expenditures, will be advanced by the formation of this division, which should result in greater economies and increased efficiency of management.

Additional purchases of privately owned municipal water supply systems by holding companies continued throughout the year. In some instances these holding corporations have been taken over by banking and financial interests. This development in the water works field, which is not new but which has made extraordinary progress in the past four years, has given rise to an increasing volume of discussion as to the obvious benefits to be derived by centralized control and management in reduction of overhead charges, in sounder development and expansion along the best engineering lines, and in economies of improved operation.

\*Consulting Sanitary Engineer, New York City.

It is to be regretted, from the standpoint of public interest, that no outstanding technical worker in the public water supply field has felt called upon during the present movement, as yet, to analyze some of the arguments advanced and to consider, impartially, the effect which such widespread consolidation of water supply systems may have in placing additional barriers against public ownership of a municipal utility in the comparatively few but yet considerable number of communities whose water supply systems are not municipally owned.

Continued attention is being given to the establishment of joint water supply districts and concerted action is being taken by groups of cities for economical development of sources. Eleven cities in southern California, including Pasadena, have started study of a project to tap Boulder Dam Reservoir and construct a 250-mile aqueduct.

Reforestation of municipal watersheds continues at an increasing rate. The first city in New York State to report on returns, Little Falls, is said to be receiving an income of over \$12,000 annually from about 1000 acres planted.

Some further progress has been made in the matter of eliminating or controlling cross-connections between potable public water supplies and polluted industrial or fire supplies at industrial establishments. After considerable discussion and the submission of a preliminary report, a final report was submitted in April by a committee of the New England Water Works Association, whose recommendations were not so rigorous as the control set up by regulations adopted recently by the New York and New Jersey State Departments of Health.

Extension of powers to Conservation Commissions and the delegating of authority to Water Control Commissions and other special commissions in the allocation of available water supply sources has been a marked development in several states during the year. In New Jersey, the Water Policy Commission has appointed five engineers to make surveys and report to the 1930 legislative session on a plan for a water-supply development which will give relief to the counties of Bergen, Hudson, Passaic, Essex, Union and Middlesex, which were affected by a drought during the

For the first time the question of allocation of water supply sources between municipalities in different states has reached the Federal courts. Following the failure of Pennsylvania and New Jersey to ratify the first tri-state Delaware river compact between these states and New York, the City of New York took steps to develop plans for an additional water supply from the Delaware river. While a second compact was still under consideration, New Jersey applied for the appointment by the Federal courts of a master to hear its objections to diversion of Delaware river water by New York, and Pennsylvania has recently applied to the courts for permission to join in the suit. The Supreme Court has declined to appoint a special master and a hearing has been scheduled for January 6,

In connection with the Swift and Ware rivers project of the Metropolitan (Boston) District Water Supply Commission, Connecticut has pending an action in the Federal courts to enjoin the Commission from diverting water from these rivers which are tributary, through the Chicopee river, to the Connecticut river. Appointment of a special master to handle the case was announced by the U. S. Supreme Court on December 2nd, and January 6 was fixed as the date on which Massachusetts may amend its answer.

Among the many topics which have engaged attention of water works men during the year at meetings or through prepared articles should be mentioned, especially, the problem of chloro-phenol taste removal, pipe leakage and joint construction, and the proper basis of meter ownership.

#### CONSTRUCTION

Completed Projects. During the year several large water supply projects have been completed while others are nearing completion at the end of the year.

One such major project is the recently completed Howard Bend plant for the city of St. Louis on the Missouri river, thirteen miles west of the city limits. This plant cost \$12,000,000 and required five years to build. It consists of a pumping station and filter plant with a normal capacity of 80 m.g.d. and a maximum capacity of 100 m.g.d. The special feature of this plant is the employment of mechanical clarifiers for pre-settling the turbid Missouri river water. It is estimated that 42 tons of mud per million gallons of water pumped will be removed from the water before filtration.

Following a 3½-year construction program, including the building of the Pardee dam and a 95-mile aqueduct consisting chiefly of 65-in. longitudinally welded steel pipe, the Mokelumne water supply project of the East Bay Municipal Utility District is practically completed and is furnishing water to Oakland, Cal., and eight other cities. The cost of the works involved was about \$39,000,000 and, including construction of local distribution systems and the acquisition of the holdings of the East Bay Water Co., the total cost of the project has been over \$74,000,000.

Projects Under Construction. Work has been commenced on the new 20-mile distribution aqueduct of the New York water supply from Hillview reservoir to Brooklyn This aqueduct will be 17 feet in diameter and located at a depth of 500 feet below sea level. The

contract cost is nearly \$45,000,000.

Bonds have been authorized to the extent of \$14.-000,000 for the Swift and Ware rivers project of the Metropolitan District (Boston) Water Supply Commission. The ultimate cost of the proposed work is estimated at \$100,000,000. It is expected to take ten years for completion and to furnish sufficient additional water supply for one hundred years.

The Wanaque aqueduct, now being built by the North Jersey District Water Supply Commission for the delivery of 100 million gallons daily to Newark, Paterson, Passaic, and other New Jersey cities, will

cost about \$5,000,000.

The Basic Creek dam and tunnel of the new Albany, N. Y., water works are completed and work is under way on the Alcove dam and conduit. Work on the last contract, for clearing reservoir sites, was started in July.

The Hetch Hetchy aqueduct for San Francisco, it

is expected, will be delivering water in 1932.

At a cost of \$30,000,000, Detroit is building a new water system for present increased and future needs. A 20-million gallon clear water reservoir at the filtration plant was recently completed, supplementing the original 35 m.g. reservoir and thereby increasing the daily output of the filters.

Springfield, Mass., is enlarging its municipal supply by constructing what will be the highest earthfill dam in the world, at Cobble Mountain on Little River,

above Westfield.

Proposed Improvements. A \$5,000,000 increase in the capital stock of the New Haven Water Company has been authorized by the General Assembly to permit the constructon of the proposed Totoket

Mountain reservoir improvement.

Seattle has under construction a 72-inch wood stave pipe line from Cedar river intake to the Molasses Creek control works at a cost of \$4,000,000. It is expected that this pipe line will be completed in the summer of 1930, whereas two years would be required to build a concrete aqueduct, although it is planned to replace the wood stave pipe, eventually, with an 8-foot concrete aqueduct. .

Sacramento voters recently defeated a bond issue proposal for \$11,600,000 for the projected Silver

Creek development.

The Delaware river project for New York is still in the planning stage. WATER SUPPLY TREATMENT

Methods. No radical changes, either in underlying principles or in the design of filtration plants, proper, have been developed during the year, except as to new combinations of processes, changes in reagents, and the adoption of minor operating improvements. A sustained preference for rapid sand filters over slow sand and pressure filters is indicated in the new purification plant designs, as has been true for the past fifteen years. In fact, water filtration practice has been developed to a much more satisfactory state of effectiveness and of maximum economy than processes in other sanitary engineering

Effort is being made, however, to overcome certain disabilities of filter plant operation, such as unequal distribution of loading, balling, and cracking of sand layers.

At Detroit, at Baltimore, and at Cleveland, considerable experimental work has been under way to determine possible improvement in filter plant operation through variation in wash-water rates.

Further reports of the success met in reducing carbonate hardness by lime softening at the Columbus and other Ohio filtration plants were made.

At several large filtration plants the newly adopted practice of employing mechanical clarifiers for presettling turbid water is noted.

Pre-ammoniation to prevent chloro-taste, and prechlorination to effect economies in the use of coagulants and to permit longer filter runs, to increase the effectiveness of sterilization and to control algae tastes, have been adopted at additional plants.

In a recent report on pre-chlorination by the Committee on Water Purification of the Conference of State Sanitary Engineers, the following facts are stated as a result of studies conducted by the U. S. Public Health Service:

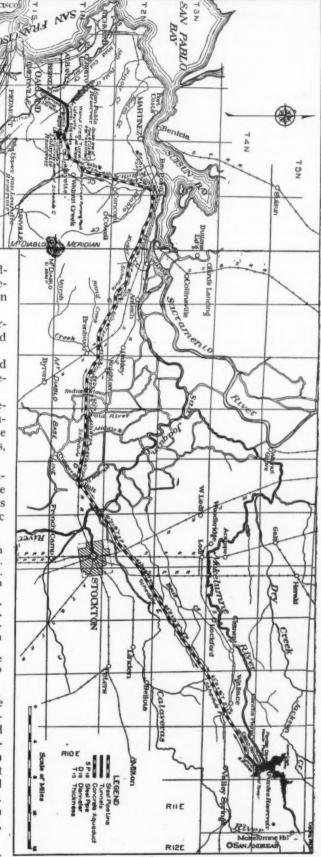
1. The maximum raw water B. coli index consistent with producing a final effluent conforming to Treasury Dept. Standards could be increased from about 10,000 per 100 cc. without prechlorination to about 25,000 per 100 cc. with chlorination.

2. The studies gave fairly clear evidence that prechlorination, if properly controlled, may be carried on without injury to the filtering medium and with beneficial effects in reduction of plankton growths in the sedimentation basins.

3. These studies indicate a clear gain through the use of prechlorination and in general this process appears to be establishing itself rapidly.

During 1929 one of the most exhaustive large-scale experiments yet carried out was conducted at Cleveland on pre-ammoniation. These studies were reported in detail to the 1929 Ohio Conference on Water Purification. The conclusions were that pre-ammoniation using 0.25 ppm of ammonia had proved to be the most effective process, from the practical and economical standpoint, of any process yet studied at Cleveland. Tastes and odors were effectively prevented even though 1 ppm of phenol was present in the raw water, and at a very reasonable cost.

Superchlorination and Dechlorination. The effectiveness of superchlorination of filtered water and dechlorination with sulphur dioxide, after the proper period of chlorine contact, has been demonstrated at



MAP OF MOKELUMNE RIVER PROJECT, SHOW-ING ROUTE OF AQUEDUCT FROM RESERVOIR TO MUNICIPAL UTILITY DISTRICT

Toronto during 1929. During the year, also, the process of superchlorination and dechlorination with sulphur dioxide for taste elimination and crenothrix control has been adopted for water from wells at one of the plants of the Jamaica (L. I.) Water Company.

Dechlorination through activated carbon beds has been under continuous study at the Chicago Experimental Filter Plant and at Cleveland, and several small-size dechlorinating plants have been installed throughout the United States during the year.

Chlorinated Copperas and Ferric Chloride. The use of chlorinated copperas (ferrous sulphate solution oxidized with chlorine) has continued to be satisfactory as a coagulant at Elizabeth City, North Carolina, and it has been adopted at Chickasaw, Alabama. Monroe, Louisiana, also employed it successfully.

At the Chicago Experimental Filter Plant, chlorinated copperas is said to have proved to be highly efficient

Ferric chloride is reported to have been found superior to other coagulants at the Wilmington (Los Angeles) plant.

L. H. Enslow has stated that, from his observations and from reports received from several sections of the country, he is confident that ferric compounds are the most efficient coagulants yet available at prices justifying consideration.

Research work at the Chicago experimental plant is being continued, and at Ottawa a research filtration plant has been constructed.

Typhoid Fever Suppression. To public health workers and students of epidemiology, the improved conditions throughout the country as to typhoid fever prevalence is an attest to the vigilance of filter plant operators. For the past few years a large part of the credit for reduction in typhoid fever death rates has shifted from water supply treatment to other public health measures, such as milk pasteurization, vaccination and general improvements in sanitation. Too strong emphasis cannot be laid on the fact, however, that the strongest line of defence against recurrence of high typhoid fever rates is the effective, and the continuously effective, filtration and chlorination of public water supplies.

From a review of government records and from the report of the American Medical Association for 1928, Dr. James A. Tobey has shown that water purification and other applications of sanitary science have reduced typhoid fever death rates in 74 cities of more than 100,000 population over 90% in twenty years. In 1910 the mortality rate in these 74 cities was 20.58 per 100,000, while in 1928 it was but 1.89.

#### SEWAGE TREATMENT

General Status. A more definite basis for substantial progress in sewage treatment has been laid during the past year and a half than has heretofore existed in the United States. Reference is made to the formation of the Federation of Sewage Works Associations, composed of state and district associations. The number of such associations has grown from nine in October, 1928, when the first number of the Journal of the Federation was issued, to fourteen or fifteen at the close of 1929. Such associations have been founded in Arizona, California, Illinois-Wisconsin-Indiana (Central States Sewage Works Association), Iowa, Kansas, Maryland, Missouri, New England,

New York, North Carolina. North Dakota, Oklahoma, Pennsylvania, Texas, and New Jersey (Sewage Conference), in addition to the pioneer New Jersey Sewage Works Association.

This very rapid increase of over 50 per cent in the number of associations and organized conferences, occurring in a little more than one year, while the first similar association was formed some fourteen years ago, is the best proof that this movement for regional cooperation and the exchange of ideas in plant design and operating experience has been long overdue.

The great benefit to be derived from the founding of such localized but affiliated groups for cooperative study, in addition to the improvement in technical design and in plant operation, will come in future years from the closer touch with the public thus afforded than is possible through a distinctly national body.

River cleaning, through the adoption of proper sewage treatment, is a problem of dire necessity on economic grounds as well as for public health reasons, and not a fad or a mere uplift movement.

From this development, which aims at more detailed attention to the subject, if proper steps to interest the public and public officials are taken, will come increased support for necessary legislation and for adequate appropriations to correct the mistakes which have been made in almost universal defilement of streams.

An interesting comment which should be gratifying to city officials and to sanitary engineers generally was made by Dr. Karl Imhoff following a visit of inspection to this country and Canada in the spring of 1929. He said that the United States has far more new and good sewage treatment plants in operation and under construction than any other country and that their great technical success is due mainly to the cooperation of consulting engineers, state sanitary engineers and city officials.

Official Control and Development. Legislative and governmental action with a view to stimulating activity in river cleaning has again been a feature in the year's record in sewage treatment progress.

In New York State a very rational step was taken by Governor Roosevelt in the appointment of a committee comprising the heads of the several State Departments interested, to investigate the subject of water pollution with the primary purpose of removing state institutions from the list of offenders. In this state, also, a permissive sewer rent law was enacted.

A cooperative study of stream pollution in Virginia was started in May. Included on the committee are representatives of the Commission of Game and Inland Fisheries, the State Commission on Conservation and Development, the State Department of Health, the League of Virginia Municipalities, and the Isaak Walton League, together with representatives of several important industries.

Cooperative action between state authorities and industries having problems of stream pollution to solve continues to develop, especially in the pulp and paper, canning and leather industries.

In Cuyahoga County, Ohio, all or parts of eleven municipalities, including some districts in Cleveland, are to be served by two trunk sewers tributary through the city system to the southerly sewage treatment plant of the city of Cleveland. This project is in line with a proposed constitutional amendment authorizing unified control in all counties throughout the state of highways, water supply, sewage disposal, street cars and rapid transit, except in purely local affairs.

Under legislative authority, in New Jersey, the Camden County Sewer Survey Commission has been organized to investigate and determine the condition of all streams receiving sewage and of all treatment plants within the county and to recommend improvements.

A most important advance step in city sanitation was taken in New York by the adoption of an amendment to the city charter providing for the establishment of a Sanitation Commission to have complete charge of intercepting sewer construction and sewage treatment, street cleaning and snow removal, and refuse collection and disposal throughout the five boroughs.

The Health Commissioners of states bordering on the Great Lakes adopted on October 2nd an agreement as a basis for official action in removing and preventing sewage pollution of the lakes and their tributaries.

On January 14, 1929, the United States Supreme Court declared the diversion by Chicago of Lake Michigan water illegal except for navigation purposes, and referred to the Special Master the formulation of a decree stipulating the definite action to be taken by Chicago in conforming to the decision. The Sanitary District of Chicago in December applied for an extension to April 1, 1930, of permission to continue the diversion of 8,500 second-feet.

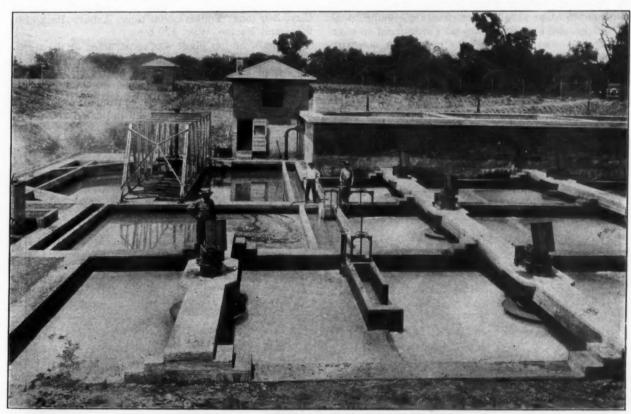
Plant Construction. Project plans for the new 180,000,000-gallon daily, activated-sludge plant on Ward's Island, New York City, has been approved by the Board of Estimate and Apportionment and by the State Department of Health. This plant, which will serve about 20 per cent of the population of the city, is exactly the type of plant to construct at this point under the present stage of the art of sewage treatment and considering the conditions to be met.

Following a delay in authorization for the issuance of bonds, work was officially resumed on October 21 on the construction of the West Side sewage treatment plant at Chicago. The plant will cost \$24,300,000 and will serve 1,800,000 population. There will be three batteries of 36 Imhoff tanks and the plant when completed will be the largest in the world

Comparative studies of over twenty projects have been made by the Metropolitan Drainage Commission for the Minneapolis and St. Paul, Minn., joint sewage treatment undertaking. Both activated sludge and trickling filter processes are being considered.

Studies are under way preparatory to designs for intercepting sewers and sewage treatment works for Buffalo. The North Toronto activated sludge plant was put into operation in August.

Development in Processes. Municipal sewage treatment research or experiment brought forth no radically new processes or types of plant during the year. Considerable research and experimental work has been carried on at New Brunswick, at the Harvard Engineering School, at the Sewage Research Laboratory of the Texas Engineering Experiment Station at the



LAWTON, OKLA., SEWAGE TREATMENT PLANT

In the left foreground reaeration or sludge conditioning tank. Behind this, the preliminary settling basin; and beyond this, final settling basin with Dorr Clarifier. At the far left corner, chlorination chamber. Beyond the Dorr Truss is the control house; at the right of it, the pump house and laboratory. At the right of this, elevated above the other tanks are the sludge digestion tanks, and in front of these are the aeration tanks. (For some unaccountable reason, operator in charge raised all the hoods over the aerator motors when these pictures were being taken; they are kept closed during use.

Agricultural and Mechanical College of Texas, and

at many municipal plants.

This research and experimental work has consisted, more especially, in the determination of the effect of various chemical reagents in facilitating sludge digestion and drying, and in further determining and developing the application of chlorine, in addition to its accepted function of disinfection, as a means for odor correction, filter ponding relief, protection of masonry sewers, relief from foaming Imhoff tanks and deodorization of gas from tanks.

Chlorination of either primary or secondary process effluents for B. O. D. reduction has been adopted at nine or ten municipal plants during the past year, in-

cluding Columbus, O., and Flint, Mich.

In North America there are now more than fifty plants employing chlorination of crude sewage for odor prevention. During 1929 the practice was adopted at nineteen plants, including the municipal plants at San Bernardino, Cal., Topeka, Kan., and Oklahoma City.

In the industrial wastes treatment field, intensive study is being given to plans and processes which will combine reclamation of stock or by-products with cor-

rection of stream pollution.

In this field chlorine treatment has been found useful in correcting "slime" difficulties and in controlling odors.

#### REFUSE DISPOSAL

Refuse disposal practice has shown but little change or progress during the year.

Except at a few large cities and at some of the better managed smaller municipalities, public officials continue to depend on commercial salesmanship or subsidized engineering advice to guide them in making decisions with reference to incinerator construction which should be based, primarily, on independent engineering study and consideration.

Such failure to secure proper engineering advice often leads to the construction of plants in unsuitable locations, to faulty layouts and improper capacities of plants and to excessive construction costs because of the lack of adequate basis for open, competitive bidding under carefully prepared specifications and general plans, or to uneconomical operation of the plant or of the collection system.

During the year New Jersey received permission from the United States Supreme Court to sue the State of New York for water pollution and shore litering as a result of the dumping of garbage and refuse from

New York City at sea.

Three refuse incinerators, each of 500 tons capacity in 24 hours, have been constructed during the year in Brooklyn at Hamilton Avenue near Gowanus Canal, at Apollo Street near Newtown Creek and at Flatlands Avenue and 57th Street.

Additional incinerators are to be built in Manhattan and the Bronx.

At San Francisco a proposal to construct a new refuse incinerator was voted on favorably at the November election. An unfortunate and anomalous decision on ownership and operation was reached, however. There were two ownership and operation propositions, one for municipal and one for contract ownership and operation, and each proposition was voted down.

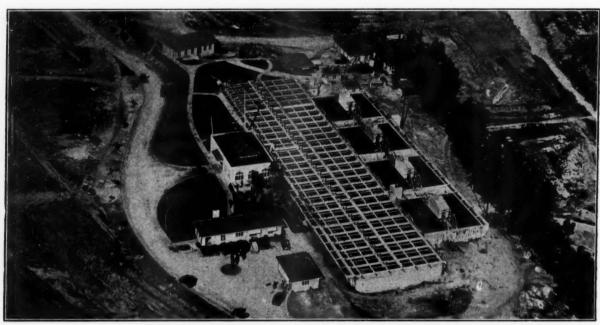
Comparatively few refuse incinerators were constructed in 1929 although improved refuse collection and disposal has been under consideration in many municipalities.

Among the larger plants completed or under construction during the year, in addition to the three Brooklyn plants, were refuse incinerators at Montreal with a capacity of 300 tons in 24 hours; Atlantic City, 240 tons; Yonkers, 200 tons; Asbury Park, 180 tons; and Racine, Wis., 120 tons.

A small, 50-ton plant was constructed at the transfer yards of the Pennsylvania R. R. in Pittsburgh, to dispose of waste vegetables and fruit.

#### RESUME

The year has been one of continued progress in municipal sanitation, as has been indicated above. Co-



AIRPLANE VIEW OF PASADENA SEWAGE TREATMENT PLANT.

operation along both technical and administrative lines among workers in this field has increased and the application of the results of the wider research work of recent years to practice in design and operation of sanitary engineering works has been more in evidence than in any other 12-month period.

A much more stable basis for proper operation of

sewage treatment plants is being built up by extension of the sewer rent plan; and definite provision, by legislation, to let public works construction to contracting firms of experience and proved reliability is being set up.

Indications point to an increased number of sanitary engineering projects during 1930.

## Pennsylvania Highway Notes

The Pennsylvania Department of Highways watches very carefully the construction of its concrete pavements to see that the contractors live up to the specifications, and tests them afterwards by means of core drills. The most definite determination by cores, of course, is the thickness. No penalty is imposed if the thickness is less than a quarter of an inch under the specified thickness. A deficiency of between 1/4 and 1/2 inch in thickness imposes a penalty of reduction in payment. If edge measurements show deficient thickness, special underpinning is provided. When a pavement is more than 1/2 inch deficient in thickness, it must be replaced by tearing up the whole slab and replacing it at the contractor's expense. Realizing this, the contractors are very careful to have the pavement full thickness. On 60 contracts covering 101 miles of pavement which were tested by drilling 1257 cores in 1929, only six were found to be between 1/4 and 1/2 inch deficient in thickness, and only two deficient more than 1/2 inch; leaving 99.3% of all the cores showing the thickness to be that called for or greater.

#### BRIDGES ON STATE HIGHWAYS

There are in Pennsylvania 2127 bridges on the state highway system maintained by counties. Of these, 858 are of steel or iron truss or plate girder design, 451 are stone or concrete arch, 245 are timber, and the rest are I-beam or concrete slab construction. The bridges vary in width, 968 having roadways of 16 feet or less and 474 having spans over 100 feet in length.

An act was passed last year directing the State Highway Department to take over all of these bridges by June 1st, 1930, or earlier. The Department has already taken over the 73 which are regarded as the most dangerous and in need of immediate attention, and contracts have been let or Department forces authorized to do work on all of these. This work varies from repairs and strengthening to replacement and relocation of the entire structure. Other bridges will be taken over as rapidly as surveys and plans can be carried out.

#### STATE AID FOR CITIES

Forty Pennsylvania cities are entitled to receive money from the state for street repairs or replacement, under an act of the state legislature, \$2,000,000 being appropriated for this purpose. Three other of the larger cities, Philadelphia, Duquesne and Monessen do not share in this, Philadelphia because it is provided for in other legislation, and Duquesne and Monessen because there are no state routes passing through those cities. This money is appropriated with the view of using it upon streets in these cities which

form links in the state highways which pass through the cities, and it is to be allocated in the ratio which the mileage of such streets in any one city bears to the total mileage of such routes in all the cities. There are 280 miles of such streets in the forty cities, giving \$7,143 per mile to be allocated. The mileage varies from a maximum of 30.45 in Pittsburgh to .2 in McKeesport.

#### PREPARATIONS FOR SNOW

Weeks before winter arrived, the Department of Highways was making preparations for snow handling. Trucks, tractors and scrapers were fitted with plows and emergency gas tanks. Rotary plows were fitted on trucks with special power take-offs on the forward end of the crankshaft. These snow handling units were distributed in more than 100 storage sheds ready for action.

In 1928 the department erected 2,179,079 feet of snow fence—nearly 413 miles—along sections of road where drifts usually have formed; the position of the fence being governed by the direction of the prevailing winds. Experience last winter proved the need of more fence and the department was expecting to purchase about 648,000 feet more, making a total this winter of 533 miles. Last winter the snow removal schedule included more than 8500 miles and the new construction during 1929 will bring the total for this winter to approximately 9000.

#### 1930 PROGRAM THE GREATEST EVER

The Highway Department states that the paving program which it expects to put through in 1930 "is the greatest ever undertaken by any state highway organization and greater than any attempted by any entire foreign nation. At least 15,000 men will be required, but the problem of assuring a steady supply of materials for uninterrupted work is a matter of concern to highway officials, who are canvassing various industries of the state and preparing schedules of delivery. An estimate of stone and sand requirements indicates the need of 4,000,000 tons of stone and 1,700,000 tons of sand, enough to load 114,000 railroad cars with 50 tons each. Adding the supply of cement and reinforcement steel, the total will call for about 1500 trains of 100 cars each.

"Arrangements are being made with quarries to have much of the material in storage ahead of time. By July 1st there should be at least 150,000 tons of stone and 85,000 tons of sand in advance of requirement."

It is expected that during 1930 peak construction will reach 40 to 60 miles of completed pavement each week, which will require about 5,700 carloads of sand and stone per week.



ONE CORNER OF AIRPORT UNDER CONSTRUCTION, SHOWING PILES OF TOP SOIL FOR DRESSING FINISHED GRADE.

## Constructing the Akron Municipal Airport

By E. A. Kemmler\* and A. R. Barbiers†

In the August, 1929, number of Public Works, F. E. Swineford, Director of Public Service, presented a general description of the world's most unique airport, combining the functions of both heavier and lighter than air craft, now under construction at Akron, Ohio.

At the request of the Editor we are now supplementing the original story with a few details of construction and costs which may be of interest to other engineers connected with airport development.

The Akron port occupies an area of eight hundred and thirty acres in a gently sloping valley having a general northeasterly and southwesterly direction, coinciding with that of the prevailing wind. The site was selected at the instance of the Goodyear Tire and Rubber Company, builders of the two super-zeppelin ships for the United States Government. It is located adjacent to the B. & O. Railroad, which also serves the Goodyear Company factories about one-half mile north. The field lies within the corporate limits of the city and about 3.3 miles, as the crow flies, from its center. It can be reached, over well-paved roads from the business center, in fourteen to sixteen minutes.

After the selection of the site and before any of the 150 parcels of land had been acquired, a general plan

was prepared, the most important features of which are as follows:

Grading, clearing and grubbing.

Main storm and sanitary sewers.

Water mains.

Relocation of two miles of the B. & O. Railroad.

Relocation of about two miles of paved roads.

Construction of rolled

embankment base for the No. 1 Goodyear-Zeppelin factory and hangar (now called dock), each 1200 feet long, 325 feet wide, and 208 feet high, located in an original swamp at the summit of the watershed in the valley.

Removal and restoration of top soil over about onehalf the area of the field, and a sub-drainage system. The plan (page 21) has just been completed and

shows the port as it will be when finished.

On October 27th, 1928, the Goodyear-Zeppelin Company announced that it had selected Akron as the site for the construction of the airships. On October 10th, 1928, the city had commenced the construction of the water main, in anticipation. On November 22nd, 1928, bids were received for the main storm drain, and on November 20th, 1928, for the clearing and grading, including that for the relocated railroad. Seventeen bids were received for the last-named contract and The Cable Company of Canton was the successful bidder. Ground was broken on November 28th, 1928, and the work has progressed at full speed since that time and is now about eighty per cent completed. The principal items included in this contract are:

1,300,000 cu. yds. Grading—Unit price 34c per cu.

yd.

90,000 cu. yds. Rolled embankment — Unit price 22c per cu. yd.

100,000 cu. yds Top soil replacement — Unit price 40c per cu. yd.

The soil is principally a gravelly clay, generally self draining, underlaid with sand rock at a depth of from ten to twenty feet. At the beginning of oper-



DRAGLINE ON TOP OF CUT PILING TOP SOIL

 Highway engineer, Akron, O.
 Resident engineer, Akron Municipal Airport. ation the contractor experimented with many types of hauling equipment, but soon discarded all except crawler type tractors, crawler wagons and motor trucks. The equipment from that time on consisted of the following pieces:

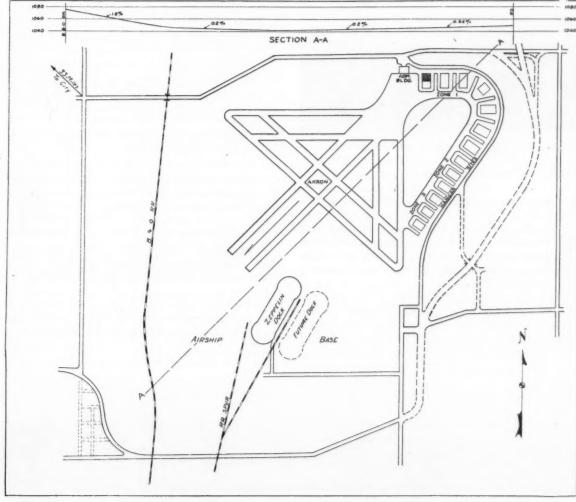
- 4 One and one-quarter yard gasoline shovels.
- 1 Gasoline dragline.
- 2 Seventy five horsepower crawler tractors.
- 4 Fifty horsepower crawler tractors.
- 4 International wheeler tractors.
- 6 Eight-yard crawler wagons.
- 4 Six-yard crawler wagons.
- 11 Three-yard trucks
- 1 Ten-ton grooved roller.
- 1 Three-ton golf roller.
- 2 Bulldozers.
- 4 Graders, including one Ryan motor-controlled.
- 2 Timber drags.

The hauls averaged about 1200 feet, tractors being used up to 1000 feet and trucks for greater distances. (The small cut, page 22, shows a twenty-yard load pro-



SCRAPING AND ROLLING AIRPORT WITH GALION-CLETRAC MOTOR GRADER AND GALION 10-TON ROLLER

pelled by a seventy-five horsepower tractor on two sixyard and one eight-yard wagons.) The average yardage per month has been a little short of 100,000 yards. Minimum yardage of 40,000 yards occurred in March, 1929, and maximum of 150,000 yards in September. About 35,000 cubic yards of sand rock is being excavated from the railroad cut, at the contract price of \$2.34 per cubic yard. Jackhamer drills were tried but these were soon abandoned and a well driller with a two-inch bit is now being used. In a rock cut twenty-two feet in depth, twelve holes are drilled and



GENERAL PLAN AND SECTION OF AKRON AIRPORT, REVISED TO NOV. 4, 1929.

approximately a ton of dynamite is used for each shot. This so loosens and shatters the material that the shovel can easily load it into trucks.

The new tracks will cross under the paved roads forming the north and south boundaries of the port. Reinforced concrete highway bridges, estimated to cost about \$100,000, will be constructed by the city and Summit County at these points.

The dragline was used for removing and piling top soil, exca-

vating temporary drainage ditches, removing muck from the swamp on the site of the docks and was a useful accessory for general grading. In removing the top soil, the dragline first stripped a ribbon of cut area along the dividing line between cut and fill, piling the soil on the fill area. Then, as the shovels advanced into the cuts, the dragline followed on top of the cut, depositing the soil on the finished grade. This operation is shown in the illustrations.

During the spring and summer the stored soil was loaded on trucks and spread over the graded areas, well smoothed with timber drags, and rolled with a



TRACTOR HAULING TWENTY YARDS OF DIRT

light golf roller and prepared for grass seeding in the fall.

During October an experimental area of about 17.3 acres was divided into fifty-four plots 80 x 175 feet and fertilized and seeded, each plot with a different mixture of fertilizer and seed, to determine the most suitable combination for producing a hardy and tough turf for lighter-than-air craft operation and heavier-than-air manoeuvering.

No final plans for sub-drainage have been developed. The main drainage system of twenty-four to sixty-six-inch conduits has been completed and laterals have been provided to collect the flow of a number of springs encountered during grading operations. The



EXCAVATING INTO TRUCKS. NOTE PILES OF TOP SOIL

net work of smaller sub-drains will be installed as and where needed, but it is not anticipated that extensive sub-drainage will be necessary by reason of the porous nature of the soil. The present air-plane landing area shown on the plan has been in operation several years without any artificial drainage and has never been out of commission from standing water.

The estimated cost of the port, when completed, is as follows:

Land, fences, etc	\$980,000
Grading	660,000
Clearing	30,000
Relocation of railroad (including	
grading)	250,000
Paved roads	200,000
Top soil and seeding	35,000
Administration building	40,000
Lighting	15,000
Runways	190,000

\$2,400,000

Incidental to the establishment of the airport, the street pavements and utilities were necessary and the city supplied them as follows:

Sixteen-inch water mains	.\$ 25,000
*Main storm-water drains	. 180,000
*Main sanitary sewers	. 230,000
*Grade separation bridges	100,000
Total	\$535,000

The telephone, gas, power and telegraph companies spent probably another hundred thousand.

The airport is being developed under the supervision of the Department of Public Service, F. E. Swineford, Director. E. A. Kemmler is Chief Highway Engineer and A. R. Barbiers is Resident Engineer in immediate charge of construction.

<sup>\*</sup> Partly completed.



GENERAL VIEW OF AIRPORT UNDER CONSTRUCTION.

## Study of Gravel, Topsoil and Sand-Clay Roads

Research by Georgia State Highway Board and Bureau of Public Roads. Composition and classification of road soils. Mixing, depositing and consolidating them on the road. Stability factors. Loss of surface material under traffic. Limits of acceptability. Economic aspects.

In 1922 the State Highway Board of Georgia and the United States Bureau of Public Roads entered into a cooperative agreement for the study of local gravel, chert, semigravel, topsoil, and sand-clay roads in Georgia. The investigation was directed to a determination of the scientific combination of soil ingredients, traffic behavior, and economic life.

A report on this research, prepared by Dr. C. M. Strahan, acting as special director of research for the State Highway Board of Georgia, was made public a few weeks ago. A research program, including inspection each spring and fall, 8-day seasonal counts of traffic, keeping of maintenance cost records, laboratory studies of soil ingredients, and yearly determinations of depths of surfacing, was carried out regularly from July 1922 to July 1927. The research covered 29 projects representing typical topographic, climatic, and subgrade conditions over a total length of 247 miles, and including roads built of chert, "red pebble" or iron silica, clay-gravel, imported gravel, artificial sand-clay mixtures, semi-gravel running high in natural quartz, and local sand-clay and topsoil.

The report gives, in tabular form, the data obtained, discusses them at length, and summarizes the more important conclusions and suggestions as follows:

The life history of road-soil surfaces reflects the combined results of original surface composition, depth, cross section, and width used, methods of mixing and consolidation, and continuous attention and upkeep by road machines. If the road soils selected lie within certain recognized limits of composition and are subjected to a traffic of moderate intensity (400 to 600 vehicles per day), the average quality and length of service are highly satisfactory, the maintenance operations are quickly and easily performed, and the cost of both construction and maintenance is gratifyingly low.

These types have a large and permanent place in highway betterment in three directions:

- (1) As the first stage of surfacing for newly graded main roads.
- (2) As the chief dependence for surfacing secondary roads.
- (3) As a valuable subgrade under higher types of surface.

COMPOSITION AND CLASSIFICATION OF ROAD SOILS

- 1. The mechanical analysis as at present used seems a satisfactory laboratory method in the premises and the definitions of coarse material, sand, silt, and clay are in the main acceptable.
- 2. Knowledge of the differences in adhesive values of clays is insufficient. The way has been opened to supply this deficiency in accord with tests suggested

by Dr. Charles Terzaghi for the identification of clays.<sup>1</sup>

- 3. Until a more accurate knowledge of the clay ingredient is available, the present limits of composition for Classes A, B, and C soil mortars may be allowed to stand.
- 4. In judging these materials, full emphasis should be placed upon the soil mortar—i. e., material below the No. 10 sieve. Weak soil mortars, even with large amounts of "coarse material," often do not give proper stability under traffic. In general, Class C mortars are not to be recommended except for very light traffic or when the surface is to be covered with a 2-inch layer of gravel, semi-gravel, or coarse screenings.
- 5. "Coarse material" above 10 per cent in amount distinctly increases the stability and durability of the surface, less with class C, and progressively more with class B and class A mortars.
- 6. "Coarse material" is most effective when present in graded sizes from 1 inch downward. Such material of micaceous, feldspathic, or slaty types is most commonly soft and soon becomes valueless.
- 7. Organic matter gives much initial adhesive strength, but is soon oxidized or blown away.
- 8. Of the total sand in a road soil mortar, that portion which lies above the No. 60 sieve is a most important factor in hardness, supporting value, and durability of the surface, especially under wet conditions. A soil mortar of this type will not give satisfactory service unless it contains a liberal percentage of sand coarser than the No. 60 sieve, except in the case of cherts.

MIXING, DEPOSITING, AND CONSOLIDATION

The natural deposits of these materials, whether surface or underground, are rarely of uniform composition. It is most important to secure fair uniformity before the road surface is consolidated.

- 1. Topsoil deposits are usually thin surface layers, 4 to 10 inches thick, and of limited area. They are loosened by plowing in one or more layers. Preferably, the loosened material should be intimately mixed by harrowing before loading and depositing. Care in plowing only to the limit of good material is an obvious precaution.
- Subsurface deposits excavated from pits should be well mixed by repeated harrowings after deposit on the road bed.
- 3. Intimate mixing is the most profitable and at the same time the most frequently violated principle of construction with these types.
  - 4. The loose material of these surfaces should be

<sup>&</sup>lt;sup>1</sup>Principles of Soil Mechanics, by Dr. Charles Terzaghi, Engineering News-Record, Nov. 5, 1925, et seq. (8 articles), vol. 95.

spread in one layer to the full depth of the surface. A 12-inch loose depth with an expected consolidated depth of 8 inches or more is advised.

- 5. Consolidation of the loose material from the bottom upward is most effective. At present, this is largely done by the wheels of construction teams and current traffic. Freshly placed surfacing which is reduced to a soft mud state by rain and is thoroughly puddled shows markedly greater strength than those which are packed with less moisture.
- 6. The packing process is accompanied by repeated shaping of the surface with road machines until the finished cross section is finally set up.
- 7. Lumpy consolidation in the early stages should be broken up by scarifying or plowing before final packing is permitted.
- 8. Current vehicle traffic need not be detoured. Its presence is an aid to consolidation but its passage over the loose surface should be guided and distributed.
- 9. Clay subgrades should preferably be rolled and crowned before the surfacing is deposited.

#### DEPTH AND WIDTH OF SURFACE

- 1. The surface material should extend from ditch to ditch. For a 30-foot road (includes ditches 2 feet wide) the main surface should be 18 feet wide with an average depth of 8 inches and with a 6-inch depth covering the two 4-foot shoulders.
- 2. The crown should be approximately one-quarter inch per foot. Heavier crowns frequently show ribs made by water flowing to the side ditches. The light crown is more easily smoothed and maintained by road machines and drags.

#### STABILITY FACTORS DISCUSSED

Reliance for results is placed upon the properties and behavior of the several classes of ingredients (clay, silt, sand, coarse material), acting by virtue of mass and internal bond developed from interlocking grains and from the action of capillary moisture forces.

The functions of the several ingredients in relation to binding strength and resistance to traffic and weather are conceived as follows:

- 1. All the ingredients present contribute to a certain total of seating and embedment stability, and furnish mass and weight resistance to traffic impacts and pressures.
- 2. The very fine ingredients, notably the clay (when in other than the liquid state), supply an additional adhesive and cohesive bond which varies with the percentage of water and the capillary structure of the mass.
- 3. The coarser sizes of sand and the "coarse material" furnish the main hardness and supporting strength, especially in wet weather. They also give the chief seating bond which the finer sand and silt and clay supplement by an embedment bond.
- 4. In a rough sense, the integrity of the surface, during dry weather and with low moisture conditions, is largely maintained by the adhesive influence of the clay in preventing surface and internal displacement of the granular materials.
- 5. This adhesive and cohesive action of the clay continues through a wide range of internal moisture content, diminishing with the increase of the moisture. It becomes negligible if the surface is very wet, or, more accurately, when the clay reaches its lower liquid

limit. Possibly, the silt plays a similar but less important part. As the cohesion, due to increasing moisture content in the road slab, approaches zero, the stability of the surface depends more and more on the mechanical bond of the sand, and especially of the coarser sizes.

- 6. The desirable composition of a suitably effective road soil may be stated as follows:
- (a) Enough clay present to cement the sand and silt in dry or low moisture condition; but not so much clay that its expansion by water will dislocate the seating and embedment bond of the granular particles, viz, the surface should maintain a constant volume.
- (b) A liberal amount of coarse sand grains to furnish an adequate seating or bearing bond, not materially affected by water content.
- (c) Only moderate amounts of silt and very fine sand. A superabundance of silt, very fine sand, and especially of clay tend to reduce percolation after rains and to hold larger amounts of water in the surface whereby the lower liquid limits of the fine ingredients are more rapidly approached, and the stability of the surface more rapidly weakened.
- 7. When "coarse material" is present or is added to a good soil mortar in appreciable amount (10 per cent or more), the hardness and durability of the surface is increased, and continues to increase until the full gravel type of surface is reached.
- 8. Maintenance of a smooth surface and crown for prompt removal of surface water is obviously desirable. But regardless of this, rain water disappears with considerable rapidity from holes or depressions, showing active percolation through the surface and rapid evaporation. The porosity of these surfaces when most densely packed is not less than 20 per cent. Thus permeability must be considered in relation to rate of gravity drainage and the attendant capillary retention in the clay and silt. Class A samples taken after long periods of rain always show high strength and no serious internal softening. The condition shown in wet weather is commonly a thin coat of sandy mud, non-slippery, one-quarter to one-half inch deep on a firm supporting surface.
- 9. The conclusion to be reached and its explanation are as follows:

For class A soils: When rain begins, the clay in the surface layers expands and tends to close the surface pores and make the surface less pervious. If a smooth crown exists, water is largely discharged into the side ditches. The expansion of the clay into the sensible pores prevents dislocation of the coarser sand grains. Entrained air aids in moisture exclusion. Abrasion by the traffic creates a thin layer of nonslippery mud which rebinds to the surface on drying out. Water collects in depressions, and either percolates through the surface or evaporates from the surface. Some weakening occurs, but owing to the sensible size of the pores and small amount of clay it is not serious.

For soils high in clay: In wet weather the expansion of the clay loosens the mechanical bond of the sand grains. Absorbed water is retained by the clay in large amount. Layer by layer, the fine materials approach their lower liquid limit, and the wheels of traffic rapidly cut the surface into deep mud. This explains why it is desirable for surface material to

extend from ditch to ditch, and why clay subgrades should be rolled and crowned. Both requirements provide better opportunity for prompt removal of percolating water to the side ditches.

10. It is found that when 15 per cent or more "coarse material" is present, the allowable amount of clay in the mortar may be somewhat increased, limited by a maximum clay content of 25 per cent of the unseparated soil sample which includes the coarse material.

LOSS OF SURFACE MATERIAL UNDER TRAFFIC

Loss of material from soil surfaces is affected by several variable factors. The most important are machining, dragging, and scarifying the surface, when concurrent with high winds or washing rains.

- 1. The loss of surface depth is progressive but not at a uniform annual rate.
- 2. The loss is not consistently related to the volume of traffic.
- 3. Surfaces with 15 per cent or more of "coarse material" resist depth losses much better than surfaces with little or no "coarse material."
- 4. The observed data indicate that in general the annual loss of thickness will be between one-half inch and 1 inch under a traffic of 400 to 600 vehicles per day.
- 5. When surfaces are reduced to a depth of 2 inches or less, their behavior is directly influenced by the nature of the subsoil. Apparently, thin surfaces on subsoils high in clay content will cut through more easily in wet weather than those on sandy loam subsoils; but not much difference is noted between thin surfaces on clay and those on very fine sand subsoil. The integrity of the surface is rapidly destroyed in both cases with the production of mud on clay subsoil during rains, and loose sand pockets and wheel ruts in dry weather on the fine sandy subsoil.
- 6. In general, when surfaces are worn to less than 3 inches it is wise to scarify and rebuild them to an 8-inch compacted depth.

#### LIMITS OF ACCEPTABILITY

- 1. This type of road surface is best adapted to light or moderate traffic densities, which this research places at 400 to 600 vehicles per day, according to composition of the surface and to the provision for constant patrol maintenance. Adequate equipment for an intelligent execution of maintenance work has much to do with both the quality of service rendered and the efficient life of such roads.
- 2. The expectancy shown by Table 5 and other research results is an effective life of 6 to 8 years under 400 to 600 vehicles daily, with a quality of service of 75 per cent, an annual distributed cost per mile of \$500, and an operating index of \$1 per daily vehicle per mile per year.

ROAD SOIL SURFACES AS SUBGRADES FOR PAVED ROADS

As subgrades under pavements, these surfaces have the following merits:

1. A well-established initial supporting value which is quite uniform.

2. A structure which is not easily softened by water or conducive to capillary rise of moisture from the subsoil below.

Not liable to damage from expansion under frost under the climatic conditions found in Georgia. Cases have been observed in winter where a firm, dry road soil surface was flanked by clay shoulders on which hoar frost stood several inches in height.

#### ECONOMIC ASPECTS

- 1. Road soils such as semi-gravel, top soil, natural sand-clay, artificial sand-clay mixtures, iron-silica pebble deposits and cherts are available over large areas of the state. Their normal cost at present contract prices may be estimated within limits of \$1,800 to \$2,500 per mile for a 26-foot surface, averaging  $7\frac{1}{2}$  inches compacted depth and requiring 3,400 cubic yards of loose material per mile.
- 2. The normal life expectancy of such surfaces with a traffic of 400 to 600 vehicles per day may be taken at 6 to 8 years before replacement.
- 3. The normal provision for maintenance should be at least \$200 per mile per year.
- 4. The annual interest charges at 5 per cent will be \$90 to \$125 per mile for the initial cost limits, suggested to be amortized as depreciation occurs.
- 5. A satisfactory annual distributed cost per mile range is from \$450 to \$650 per mile per year, with a corresponding operating index close to \$1 per year when a traffic density of 400 to 600 vehicles per day is reached. This gives a highly satisfactory service quality expressed as 75 to 80 per cent.
- 6. Traffic above 800 vehicles per day increases the maintenance cost and lowers the life expectancy to a marked extent, except with semi-gravel surfaces containing more than 25 per cent of "coarse material."
- 7. The data secured by the 5-year study of road soil surfaces is deemed sufficient to establish the economic basis suggested for these types.

#### ATTAINMENT OF BETTER RESULTS

Despite the many variables involved, knowledge and methods now available enable the engineer to secure very substantial road service from these road soil surfaces at a remarkably low cost. There is, however, the possibility of further improvement. Better results in service and durability can be reached mainly along the following lines:

1. Greater care in construction with regard to the details which affect uniformity of composition and intimate mixing before consolidation.

2. Improved types of machines for quickly and more uniformly packing the loose material from the bottom upward.

3. The abundant use of water during the consolidation stage, either by taking advantage of rains and scarifying or puddling the surface before its final consolidation is permitted, or by the most liberal use of sprinkling carts which circumstance and finances permit.

4. A more intelligent appreciation and specific knowledge on the part of both engineers and contractors of the possibilities attainable.

#### SUGGESTIONS FOR FURTHER RESEARCH

A prerequisite for substantial improvement in results with road soils is a more definite knowledge of the quality of the clay ingredients. As a result of the Terzaghi experiments the way has been opened to attain such knowledge. It will require patience, special apparatus, and specially trained men, but the effort will be fully repaid in applying such knowledge on the immense nileage of the low-traffic public roads yet to be improved.

## Study of Chlorination Efficiency

Efficiency and limitations of chlorination in water purification. Study of results in over thirty municipal plants, by committee of Conference of State Sanitary Engineers.

The Committee on Water Purification and Treatment of the Conference of State Sanitary Engineers has presented a progress report on the "collective study of chlorination as a measure of water purification, with particular reference to its efficiency and limitations," which was one of two special subjects allotted to it by the conference. That part of the committee's report referring to this subject was as follows:

According to the original plan of this study, an effort is being made to collect, from representative water purification plants located in various sections of the country, data bearing on the efficiency and reliability of chlorination, as ordinarily practiced in con-

nection with filtration processes.

At the time of the institution of this study, the primary object in undertaking it was to seek more light on the much-debated question as to whether chlorination should be considered as an external factor of safety to filtration processes or as an integral part of such processes. A secondary objective was that of undertaking to set up a normal efficiency ratio for water chlorination, if such a ratio were found to exist, and to determine, as far as practicable, the extent to which it may be affected by various modifying factors, such as temperature, time, bacterial density and the presence of chlorine-absorbing substances in the water treated.

A considerable amount of fairly definite evidence on the foregoing questions has been afforded by the results of surveys of over thirty municipal water purification systems, supplemented by experimental studies, which have been completed by the Public Health Service during the past year. These results, some of them as yet unpublished, have been made available to the committee and will be discussed briefly in the remaining portion of this report.

Bearing on the question of whether chlorination should be regarded as a factor of safety or as an integral part of water filtration processes, the results of the studies above noted have indicated that when unaided by chlorination, such processes cannot produce effluents conforming to the revised Treasury Department B. coli standard, if the average B. coli index of the raw water exceeds an amount falling below that of a large majority of raw water supplies actually being delivered to filtration plants in this country.\* Under these circumstances, it would appear that, in order to produce final effluents meeting such a rigid standard of quality as that above indicated, filtration plants treating polluted waters of the type more commonly met in the United States must depend on chlorination as an integral and essential part of their equipment. That this necessity is well recognized is attested by current practice in this respect.

Although a portion of the total bacterial efficiency of chlorination undoubtedly serves as a factor of safety in many instances, the extent to which it thus serves quite obviously varies according to the margin existing between the actual degree of raw water pollution and that which may be permissible, as a maximum, consistent with the production of chlorinated effluents of specified bacterial quality. The Committee

does not undertake at this writing to define the relationship existing between these two variables more exactly than previously has been indicated,† but hopes to be able to do so if a normal relationship between the bacterial efficiency of chlorination and its modifying factors can be more

firmly established.

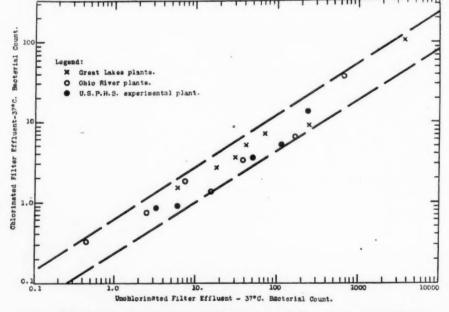


FIG. 2—RELATION BETWEEN BACTERIAL COUNTS IN UNCHLORINATED AND CHLORINATED EFFLUENTS AS DERIVED FROM THREE DIFFERENT SERIES OF OBSERVATIONS. (BACTERIAL COUNTS, 24 HRS., 37°C.)

\*For river waters of the Ohio type, the limiting raw water B. coli index corresponding to a standard quality of unchlorinated effluent has been found to be about 60 per 100 c. c. For Great Lakes waters, the corresponding maximum appears to be less than 10 per 100 c. c. These units represent B. coli densities lower than actually were observed, as yearly averages, in any of the raw waters of these two respective types encountered among the thirty-two plants included in the surveys.

thirty-two plants included in the surveys.

†Chlorination in Relation to Factors of Safety for Water Purification Processes. Appendix to 1925 Report of Committee on Control and Limitation of Chlorination of Water Supplies, Conference of State Sanitary Engineers.

As regards the possibility of establishing such a relationship, some of the data made available during the past year have afforded interesting, though somewhat contradictory, evidence on this point. In Figure 1 is shown a plot of the average relationships observed between the bacterial content of unchlorinated filter effluents and the residual percentages of bacteria in the chlorinated effluents of: (a) a group of Great Lakes plants, (b) a group of Ohio river plants, and (c) the Public Health Service experimental plant at Cincinnati. In Figure 2 is shown a logarithmic plot of the corresponding relationships observed between bacterial contents of the unchlorinated and chlorinated effluents. In each chart, a very fair degree of consistency is indicated between the three plots, suggesting that the relationship between bacterial efficiency and density of plate-growing bacteria in the untreated water has a tendency toward normality, when the av: ige performances of different groups of plants are compared.

Corresponding relationship plots based on parallel B. coli data present, however, a less consistent picture, as is shown in Figure 3. In this instance, the marked divergence in the slope of line "B" from that of the other two plots is explainable as being due largely to a single difference in the method of B. coli enumeration followed in the Ohio river observations, as compared with that followed in the other two series.\* The lower position of line "A" in reference to that of line "C," indicating a higher general level of B. coli removal by chlorination at the Great Lakes plants, is attributable mainly to the higher amounts of residual chlorine usually carried in the final effluents of these plants, in comparison with those present in the effluent of the experimental plant. As the amounts of residual chlorine carried in the effluents of the Great Lakes plants probably approach closely the upper limit of tolerance in this respect, and as those carried in the experimental series were about as low as could be car-

ried with safety (being restricted within 0.05 p. p. m.), it is likely that lines "A" and "C" mark approximately the two extreme ranges to be expected in the normal efficiency curve of chlorination with respect to B. coli removal. These two lines undoubtedly show the normal trend of the curve much more closely than does line "B."

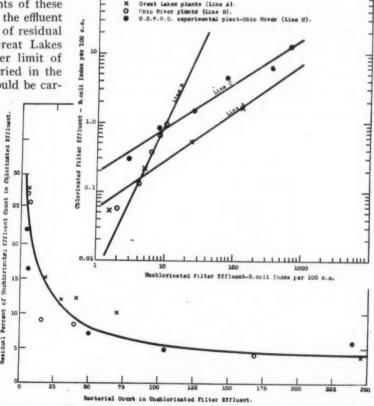
The foregoing indications are instructive in suggesting the desirability of taking account of the residual chlorine factor in undertaking to establish a normal curve of chlorination efficiency, and likewise the necessity of basing such observations on carefully standardized B. coli data. To meet these two requirements in collecting performance data from plants located in widely scattered areas will add very considerably to the difficulty of the task. It is indeed a question as to whether the value of results to be obtained from such a widespread survey can be as valuable as would a more limited series of controlled observations, either on an experimental scale or at a few carefully selected plants. It is hoped that discussion of this progress report will bring practical advice on this point to the Committee for its guidance.

Another phase of chlorination, as related to water purification practice, which has been of interest to the committee is the increasing use of raw water prechlorination as a preliminary stage of treatment. Results of comparative studies of the efficiency of bacterial removal, observed at several plants before and after prechlorination was instituted, have been published by Enslow† during the past year. Within the same period the Public Health Service has completed over a year's experimental study of the effect of prechlorination on the bacterial efficiency of rapid sand filtration, involving parallel observations on the same raw water, with and without prechlorination. Both the studies recorded by Enslow and that made by the Public Health Service have indicated a clear gain in over-all bacterial efficiency effected through the use of prechlorination. The latter series of tests showed, also, that the maximum raw water B. coli index consistent with producing a final (rechlorinated) effluent conforming to the revised Treasury Department standard could be increased from about 10,000 per 100 c.c. without prechlorination to about 25,000 per 100 c. c. with prechlorination. Some observations recorded by Enslow have indicated that prechlorination results in

†Municipal News & Water Works, August, 1928.

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Bacterial count in Dealerinated Filter Hillsent.
FIG. 1—RELATION BETWEEN 24-HOUR, 37°C. BACTERIAL COUNTS IN UNCHLORINATED FILTER EFFLUENTS AND RESIDUAL PERCENTAGES OF SUCH COUNTS IN CHLORINATED EFFLUENTS
ABOVE—FIG. 3—RELATION BETWEEN B. COLI INDEX OF UNCHLORINATED AND CHLORINATED FILTER EFFLUENTS AS DERIVED FROM THREE DIFFERENT SERIES OF OBSERVATIONS

<sup>\*</sup> See Public Health Bulletin No. 172, pp. 81-84; also Reprint No. 1170 from the Public Health Reports, pp. 11-14.

a measurable economy in coagulants and in a lengthening of filter runs. Although the Public Health Service tests failed to confirm these two observations to any well-marked extent, they gave fairly clear evidence that prechlorination, if properly controlled, may be carried on without any material deterioration in the condition of the filtering medium and with beneficial effects in minimizing plankton growth in sedimentation basins. In general, prechlorination appears to be establishing itself rapidly as an added stage of purification in connection with rapid sand filtration, particularly in the treatment of variable and highly polluted raw waters.

As regards the effects of time, temperature and chlorine-absorbing substances on the efficiency of chlorination, experiments by the Public Health Service have indicated, broadly: (a) that the time required to attain a given degree of bacterial reduction appears to bear a fairly definite relation to the concentration of residual chlorine, these two variables being inversely related to each other, (b) that the bacterial efficiency of chlorination is affected by temperature, being somewhat greater at higher temperatures, and (c) that the presence of chlorine-absorbing substances affects the added amounts of chlorine necessary to produce a given degree of efficiency, but the controlling factor in

such efficiency appears to be the residual chlorine content, rather than the amount of chlorine added; hence the effect of chlorine-absorbing substances on the efficiency is only an indirect one. The data on which the foregoing statements are based are too extensive to be presented adequately here, but will be published at a later date.

The membership of the Committee on Water Purification and Treatment comprises R. D. Bates, G. F. Catlett, H. B. Foote, H. E. Moses, J. H. O'Neill, S. T. Powell, F. H. Waring, Abel Wolman and H. W Streeter, chairman.

#### Welding Bridges

As an indication of the increased use of welding in various steel structures, Frank P. McKibben has reported a list of 140 structures up to August, 1929, of which 14 are bridges, 65 are buildings, the remainder are cars, tanks, planes, ships, etc.

Most of the bridge work was reinforcing, although three comparatively small bridges were built originally by welding. Six of the bridges were highway bridges, 6 were railroad bridges and 2 were small foot bridges.

#### Basin Top and Sump

For directing gutter flow into inlets on steep streets.

#### By C. R. Spencer\*

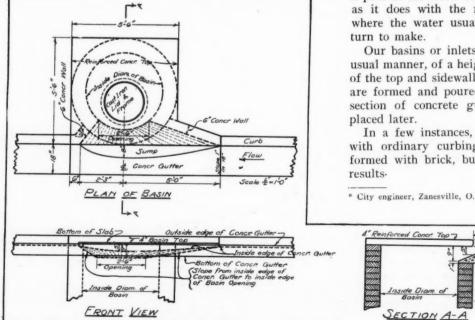
The accompanying drawing shows a reinforced concrete basin top and sump that has worked very successfully in this city (Zanesville, O.), particularly on streets with steep grades. The top, probably, is not out of the ordinary; but the opening and sump,

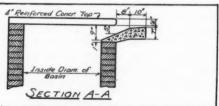
which are designed as a part of the basin or inlet construction and may be used with either a curb or a combined curb and gutter, are so shaped that the flow of water is directed inward and down toward the basin before it actually reaches the basin opening,

which practically eliminates the tendency of a part of the water to flow past the opening, as it does with the regular basin opening, where the water usually has a right angled turn to make.

Our basins or inlets are constructed in the usual manner, of a height to allow the placing of the top and sidewalls of the opening, which are formed and poured at one operation, the section of concrete gutter and sump being placed later.

In a few instances, on brick-paved streets with ordinary curbing, the sump has been formed with brick, but concrete gives better





PLAN AND SECTIONS OF ZANESVILLE STREET INLET TO BASIN

## THE EDITOR'S PAGE

#### A Happy New Year and a Prosperous One

This country was never so prosperous as in 1929 and we believe it will be even more so in 1930. There is no reason why it should not be—except one, and no reason in that one.

The papers a few weeks ago broadcast the news that a few lost money gambling in Wall Street. The amounts of real money involved have been greatly exaggerated. The number of those who lost may have reached 100,000, 200,000, possibly half a million. Well, what of it? Even the largest figure is less than half of one per cent of our population.

Moreover, except for a few "plungers," most of the losses were luxury money. They may cause a few less purchases of radios and automobiles this Christmas, but they have not diminished the losers' business capital, and certainly not their ability to pay taxes.

And taxes are what count most for us in the public works field. Moreover, this year our work will be paid for by taxes collected on last year's profits and valuations, which were generally the highest ever. Again moreover, to make sure we will have all the work we can do, Congress is increasing by more than fifty percent the federal aid for highway construction, and the governors of most of the states have assured President Hoover that they will speed up public works to the limit in their respective states.

Read the article on page 44.

It looks to us as though the only limit to the amount of public work done this year is going to be ability to get the equipment and labor to do it with. Manufacturing equipment takes time, and some equipment manufacturers seem to be a little timid about stocking up before orders come in. The wise contractor, in our opinion, is going to anticipate a record year and order equipment accordingly and at once—or at least as soon as he has learned the latest developments by a visit to the "Road Show" this month.

And don't bid too low! If, as seems certain, there will be plenty of work for all, low bids will be unnecessary. You can't all get the first job; and as long as there will be plenty to follow, why lose money for the privilege?

This matter of bidding losing prices has been one which we, and others, have discussed frequently in the past. We hope it will before long disappear as a subject calling for attention. The contractors themselves are partly but not wholly to blame. Governmental competition in construction is a factor, but one which fortunately is decreasing, except perhaps along the Mississippi. We believe that the policy is generally a destructive one, although there may be reasons in isolated cases why it should be advantageous.

The part that continues to be played in the construction industry by unqualified and irresponsible bidders needs to be brought home still more emphatically to our cities, counties and states. Part of the onus can be charged to political influence, part to lack of proper laws, part to the inclination of some engineers in public service to take the easiest way out, which is to award to the lowest bidder.

Engineers in public employ also have their troubles, which we would be glad to help ameliorate. We hope to help secure fair play for all engineers and more consideration for the young man just coming into the profession. Engineers as a class are notoriously underpaid. Whether this is because their training tends to inhibit any inclination to put themselves forward and assume responsibility for which their experience fits them, or because the public and its officials have not yet been educated to the value of the engineer, the condition should be corrected. In too many cases young engineers in public employ are not given a sympathetic opportunity to learn and progress; this is especially true of the public health engineering field.

Public officials also have their troubles; chief of which is the difficulty of satisfying a myriad of uninformed and unreasonable taxpayers. Fortunately, in most cases complaints about the services rendered by an official are due chiefly to lack of information about them; and with this remedied, his troubles from this source should become negligible. Aiding in the removal of this ignorance of taxpayers is another of our aims.

#### A Two Million Mile Road Program

In spite of the large amount of road work done during the past ten years, two million miles of roads in the United States never have been improved. The most important roads have been selected and a program for improving them prepared, but no comprehensive plan has been formulated for the others; in fact, at first the enormous mileage involved in such an undertaking seemed to render it impracticable and almost unthinkable.

But the carrying out of the program of first-class roads has now reached the point where they should share consideration and funds with the light-traffic ones. (Ninety-five per cent of the mileage approved for Federal aid by the Bureau of Public Roads is completed or nearing completion.) We will spend on road work this year from two to two and a half billion dollars, about half of it for construction. If half of the latter be allotted to low-cost roads, we will have \$500,000,000 or \$600,000,000 available. \$5,000 a mile would suffice for at least the first stage of improvement of such roads, giving 100,000 miles or more of road improvement a year. At this rate it would require twenty years for completing such a program. This seems a long time, but the "good roads" movement has already been active longer than thatthe American Road Builders' Association was organized twenty-seven years ago. Moreover, we believe that when the contractors and equipment for doing three billion or four billion dollars worth of work a year to advantage are available, the additional funds will be.

The time would seem to have arrived for seriously considering and promptly perfecting a program for all of these two million miles of road for which low-cost improvement is adequate, until every farm in the country can be reached by automobile at all seasons of the year.

#### Chicago's Experimental Filter Plant

Description of plant completed in 1928, and outline of experiments being conducted and some conclusions therefrom.

Chicago began conducting experiments in an experimental filtration plant in April, 1928, with John R. Baylis as physical chemist in charge; although it was not until September that all parts of the plant could be put in operation. Prior to this, however, experiments had been under way in the laboratory and much had been learned about the characteristics of Lake Michigan water. The following account of the plant is from the annual report of Mr. Baylis.

DESCRIPTION OF THE PLANT

The experimental plant is housed in a frame building with stucco on the outside. The grounds around the plant have been graded and beautified, and this together with the attractive exterior of the building, gives a very nice appearance from the outside. Being located in a fashionable residential section, it is evident that the structure should not detract from the surroundings. The main parts of the plant are constructed of reinforced concrete or steel, following to a large extent customary filtration practice in the materials used.

The thought foremost in mind when designing the plant was to be able to conduct experiments with only one variable; that is, the variable would be the thing being tested. If rates of filtration are being tested, then everything else would be the same through every process until it reaches the filters, where it will divide and go to the several filter units set to operate at various rates. The range of filtration rates desired is obtained by having a number of units operating at the same time rather than operating one or two units over a period of time at certain rates and then changing the rates over another period of time. This method of conducting experiments will be followed for tests on the size of sand, kind of sand, depth of sand, time of mixing for coagulating the water, time of settling, and probably other tests

The main features of the plant may be summarized as follows:

- A balancing tank for keeping a uniform head of raw water in the control valves.
- Four chemical solution tanks and one dry feed machine. With this equipment, three kinds of chemicals may be handled at the same time.
- 3. Three mixing basins.
- 4. Four settling tanks.
- 5. One small settling tank with five compartments.
- 6. Twelve filters. Two of the filters have a sand surface area of 100 sq. ft. each, and the other ten have a sand surface area of 10 sq. ft. each.
- 7. Two clear water reservoirs.
- 8. One wash water tank.
- 9. Two wash water pumps.
- 10. Carbon dioxide generating plant.
- 11. Two chlorinating machines.
- 12. Chemical laboratory.
- 13. Bacteriological laboratory.
- Facilities for the public obtaining drinking water.

METHOD OF CONDUCTING EXPERIMENTS

The work has been divided into 44 subjects and is outlined below. This outline is subject to change as the experiments progress.

- 1. Chemical Treatment:—a. Aluminum sulfate; b. Ferrous sulfate and lime; c. Chlorinated iron; d. Excess lime treatment; e. Lime and soda ash; f. Sodium aluminate; g. Recarbonation.
- 2. Mixing Basins:—a. Type of basins; b. Time of mixing; c. Violence of agitation.
- 3. Settling Basins:—a. Size and type of basins; b. Rate of settling produced by various treatments; c. Sludge removal.
- 4. Filters:—a. Rates of filtration; b. Size of sand; c. Kind of sand; d. Depth of sand; e. Gravel; f. Underdrains; g. Controlling apparatus; h. Washing; i. Surface wash; j. Air-binding of filter beds; k. Cause of clogging; l. Reverse flow agitation in lieu of washing during periods of short filter runs.

5. Chlorination:—a. Prechlorination as an aid in chemical treatment; b. Prechlorination as an aid in lengthening filter runs; c. Prechlorination as an aid in keeping the sand beds in good condition; d. Chlorin required to make the water safe bacterially.

6. Removal of Tastes and Odors:—a. Removal of phenol by excess chlorination; b. Removal of other tastes and odors by excess chlorination; c. Activated carbon for the removal of phenols and other taste producing substances; d. Activated carbon for dechlorinating water treated with an excess of chlorine.

7. Filtration Without Chemical Treatment:—a. Slow sand filtration; b. Rapid fine sand filtration; c. Rapid coarse sand filtration; d. Methods of filtration frequently used for industrial purposes.

8. Miscellaneous Items:—a. Duplication of plant results in the laboratory; b. Measurement of the volume of coagulated matter; c. Methods of testing for phenols; d. Microscopical counts; e. Effect of the size of unit on filtration results; f. Special equipment and devices; g. Effect of certain trade wastes on filtration.

No description of the experiments being conducted would be complete without mentioning the part the laboratory plays in the work. Many of the problems are attacked first in the laboratory and then in the plant. It is possible to conduct experiments in the laboratory at a much less cost than they can be conducted in the plant. Not only this, but conditions can be varied greatly beyond the ranges of what may be accomplished in a plant. This is frequently of great value in the interpretation of results or of obtaining specific proof of some point. The idea has prevailed heretofore that very little could be learned from the laboratory as to the performance of a filtration plant. This has been due to the lack of the right kind of equipment and a knowledge of how to conduct experiments. For our work, use is made of several pieces of equipment not found extensively in water laboratories.

RESULTS OF THE EXPERIMENTS

The outstanding development of the experimental work is that treatment of the water with aluminum sulfate will not handle the microscopical troubles. There is a period of from 5 to 8 months each year in which the filter runs would be so short that the operation of a large plant using aluminum sulfate for the coagulant will be difficult. Within this period, there are 6 to 8 weeks in which the filter runs would be so

short as to almost put the plant out of business. This means that some other coagulant will have to be used at least part of the time, and provisions should be made for handling such other treatment as may be necessary. Both the iron and lime treatment, and the excess lime treatment, so far have produced satisfactory results under all conditions. A large plant should be designed so that either of these treatments may be used at least during periods of high microscopical growths.

Experiments to date indicate that rates of filtration in excess of that of customary practice may be used. If future work confirms this, there will be a material saving in the cost of the new plant. This alone will likely be much more than the total cost of the experimental work. The experiments are also showing that chemical treatment followed by rapid sand filtration is much to be preferred to slow sand filtration. A method has been found for removing phenols, excess chlorine, and other taste producing substances from water. There is some doubt as to whether the pollution of the lake water will require anything unusual, but it is gratifying to know that it can be done at a cost within the bounds of what a city can afford to pay.

It has been found that our laboratory procedure gives excellent duplication of plant results. very gratifying, for it enables us to make use of a large number of experiments conducted in the labora-

tory prior to starting the experiment-

#### Advantage of Proper Meter Sizes

The water pipe extension division of the Chicago Water Works, which has charge of meter testing and control, has for some years been investigating the relation of size of meter to quantity of water passing through it, and changing the size of meters to that most suitable for the service rendered. The diagram shows the average daily registration of 501 meters for the years 1925, 1926, 1927 and 1928. The totals were compiled from meter readings taken from 501 meters 3 inches and larger in size which have been changed since 1925. The average increase in registration has been 25.1 per cent. The increase in registration obtained on these meters has been constant since the meters were changed. As much registration will be obtained on the average in four years' time as would be obtained in five years' time from meters of improper size and type. The changes in size of meters in practically all cases have been from larger to smaller sizes, which has resulted in increased accuracy of registration of water passed, thus accounting for the 25.1 per cent increased registration noted above.

The annual increase in revenue obtained by changing these 501 meters amounts to \$53,360. Moreover, since the change was generally a reduction in size, the capital cost of the meters was reduced.

#### Chlorine Used In Chicago Water

In his latest annual report, H. H. Gerstein, assistant sanitary engineer in charge of the Division of Water Safety Control of Chicago, states that during the year 1,425,925 lbs. of chlorine were used to disinfect the public water supply. The average dosage of chlorine applied at pumping stations was 3.44 pounds per million gallon, as compared with 3.46 pounds the previous However, the average dosage calculating the total chlorine applied both at the pumping stations and for pre-chlorination at the 2-mile crib was 3.86 pounds as compared to 4.07 pounds for the previous year; the reduction being made possible by a change in method of chlorination at that point.

There are a number of periods of abnormal absorption of chlorine during the year. A period which was considered the most potentially dangerous occurred in January at the 68th Street, Roseland and Thompson pumping stations. It was found necessary to apply chlorine at the rate of 10 pounds per million gallons to maintain a sufficient residual at the 68th Street pumping station. Most of the other abnormal periods occurred during the month of April, due probably to the continued southerly wind which brought pollution from the Calumet and Indiana harbor district to the intake crib, and to the continued north wind which disturbed the lake bottom and put a large amount of suspended matter in the water.

		1926 ORIGINAL METERS 1927 CHANGED METERS				1927 ORIGINAL METERS			
	OCT. Nov. DEC.	JAN. FEB. MAR.	APR. MAY JUNE	JULY Aug.	OCT. Nov. DEC.	JAN. FEB. MAR.	APR. MAY	JULY AUG. SEPT.	OCT. Nov
Number Of Meters Averaged	41	90	172	181	265	329	287	288	109
3500								mm	
F.	-	CHAN	ED ME	TERS-				26.8%	
3000							34.51°		23.3
Z 2500		,,,,,,,		29.9%	22.7%				
ATION 2000	26.4%		12.8% AL ME	V		245%			
GIST				REGISTR					
A I I									
0			ALL 3	RAPH DR. TERS. T OR LAR ERIOD OF	HESE MI GER IN	ETERS ME Size. Me EAR Pric	TER REA	DINGS ANGE	+
AVERAGE			THE CO	E YEAR	OF AVE	RAGE DAI	WERE US	TRATIONS	ì.

COMPARATIVE STUDY OF AVERAGE DAILY REGISTRATION OF METERS REDUCED IN SIZE

#### Hartford Water Department Notes

Prefiltering; water waste survey; test for coefficient of friction; Nepaug reservoir; day labor work; duties of water boards.

Prefiltering. "As operated at present, the West Hartford filter plant has an available capacity of about 25 million gallons per day. . . . It is evident that . . . additional capacity will be required. While there is opportunity for the construction of additional slow sand beds at West Hartford, it is probable that the better plan may be to install pre-filters of the so-called rapid sand type at the source of supply. Such filters, operating entirely without the use of chemicals, will so prepare the water that the rate of filtration on the present beds can be very greatly increased and water produced similar to that now supplied, at a cost less than if additional slow sand filters were installed. This method is one in vogue in England and in many of the continental countries and its use was anticipated when the design was made for the filters recently installed."

Waste Survey. "During the summer of 1924 a waste survey under the direction of the Pitometer Company of New York was made. . . . Following the completion of the work by the Pitometer Company, the Department undertook a test of two strictly residential districts. . . . During the past summer this work was again resumed and a survey of the complete system begun. For purposes of this survey, the system was divided into twenty-two districts. The method of procedure was the same as in former sur-

veys, and, briefly, is as follows:

"Each district was entirely segregated from the rest of the system and fed through a single line for a period of twenty-four hours. From this it was possible to get the twenty-four hour-consumption as well as the minimum night rate. Wherever the minimum night rate exceeded 50 per cent of the total twenty-four-hour consumption, the district was further sub-divided and a search made for leakage. This survey resulted in the detection and stopping of leaks aggregating 409,000 gallons per day. The largest single leak amounted to 110,000 gallons per day and was caused by a blown joint. The next largest leak amounted to 59,500 gallons per day. It will be seen from this that no extremely large leaks were found and that the system is in fairly good condition."

Day Labor Work. "A careful comparison of the results obtained by contract work and by the day labor forces of the Board indicates that while it is possible to obtain prices which seemingly are very attractive yet in the end the work done directly by the Board is much to be preferred as to character, convenience to citizens and probably as regards ultimate cost."

Supply Main Tests: "Tests to determine the coefficient of friction 'C' (Hazen and Williams) were made on the 30-inch concrete pipe line from reservoir 5 to 6; on the 48-inch concrete pipe line between the filters and the 48-inch conduit, and on the north 42-inch cast iron pipe line from the filtered water basins to the cross connections east of reservoir No. 1.

"The results of these tests with the results of tests on other supply mains are tabulated below:

Coe	efficient o	f Friction	n ("C")
771 7 7 7	Years of	Hazen &	ż
Kind and Locations	Service	William	s Chezy
30-inch Concrete—Res. 5-6	New	146	135
48-inch Concrete, tunnel to filters	6	126	121
42-inch C. I. filtered water basin	1		
to cross connection	6	110	107
42-inch C. I., Fern Street	91/2	115	110
42-inch C. I., Nepaug pipe line	8	100	101
(( ) 7 . D . C . CO. 1			

"Nepaug Reservoir: This source of water supply is located about fourteen miles northwest of Hartford and about a mile west of Collinsville on the state road leading to Torrington. Here there is a watershed of about 32 square miles, a reservoir with an available capacity of 7,240,000,000 gallons and an estimated usable yield of 25,000,000 gallons per day.

"The vegetable matter on the bottom of a new reservoir is of great detriment to the quality of the water in the first years of its use. In the case of the Nepaug reservoir, ten years has been necessary to get the quality of the water to its best condition.

DUTIES OF WATER BOARDS

"With a water supply as with any other going concern, its work is never done; new conditions demand new methods as well as increase in consumption requiring additions to the sysetm—there can be no completion to the work of water supply to a large city.

"A major function of the Board of Water Commissioners is to keep pace with demands and to so foresee the future that while plant and equipment may be ready when necessary, the work may be done at a minimum of expense not only in actual cost but in so planning that the expenditure be made neither too early and so waste money in interest charges, nor too late and so bring damage to the city and annoyance to consumers.

"For one reason or another, oftentimes boards of directors were reluctant to assume the burden of the increased expense over ordinary requirements which now cost several times what they formerly did. In addition to this, municipal boards are prone to defer really necessary expenditures in order to make what looks like a good financial showing. While this practice makes an apparently good financial showing during the incumbency of the board, it not only reacts on the plant but also leaves to successors the burden of making good, deficiencies resulting from inertia, neglect or failure to appreciate the requirements of a water supply business."

From the Seventy-fifth Annual Report of the Board of Water Commissioners of Hartford, Conn.; C. M.

Saville, manager and chief engineer.

#### Federal Aid for Wisconsin Highways Withheld

Federal aid for Wisconsin state highways will be withheld until the state legislature alters its laws to conform to the federal highway act, according to a recent statement of L. E. Boykin, chief of the division of contracts and highways laws of the United States Bureau of Public Roads at Washington.

The present Wisconsin law, Mr. Boykin said, provides for county supervision of roads, while the federal highway act prohibits the federal government from aiding in state road construction unless the roads are under direct supervision of the state.

The 1930 allotment for Wisconsin is \$1,854, 580.

# Some Observations of Air Currents in Covered Sludge Beds

By J. F. Laboon\*

Tests of effect of various systems of sash openings on circulation of air, and consequent rapidity of drying, in glass-covered beds at Torrance, Greenwich and Lodi. Inward-swinging side sash found best.

With more general use of glass enclosures for sludge beds, the question of obtaining dried sludge in a minimum of time becomes of importance if the enclosure is to be designed on an economic basis. Some designers use a sludge drying ratio for glass enclosed beds as compared to open beds of as much as three to one. Glass enclosed sludge beds have the distinct advantage of assimilating heat from the sun, thus adding acceleration to the evaporation of the moisture from the sludge. Rain and snow are kept off the beds, too, thus removing a retarding influence during the drying period.

A positive factor in the drying process is ventilation, inasmuch as the moisture-laden air inside of the glass enclosure must be displaced properly with air of less moisture, and the difference between the vapor tension of the air above the sludge and of the water contained in the sludge must be maintained as high as possible if optimum drying is to be accomplished. Engineers have already given data and their experience and opinions regarding the relative merits and capacities of glass enclosed and open sludge beds, but this paper will deal only with observed facts regarding the effects of certain types of ventilating sash.

Some enclosed beds have been designed with side walls of concrete or brick extending in some cases 10 feet or more above the sand surface, to the detriment of efficient drying; but the majority of enclosures have the glass sash much closer to the sand surface and, consequently, better results are obtained with such arrangements. The majority of enclosed beds may be said to have ridge ventilating sash opening out and side sash in one or two rows with at least one row swinging outwardly. There has been some doubt as to the efficacy of outward swinging side sash and, therefore, in the design of the glass enclosure for the sludge bed of the sewage disposal plant of the State Hospital at Torrance, Pa. (Blairsville Intersection), the bottom sash were made to swing inwardly and the side sash in the next row above to swing outwardly. The ridge sash were made to swing outwardly in the conventional fashion.

To check up on the theory that the bottom sash, swinging inwardly, would induce a greater number of air changes inside of the enclosure than the same sash swinging outwardly, some smoke candle tests were made of the Torrance glass enclosure after it was completely erected. These tests were made possible by the material assistance rendered and deep interest displayed by F. B. Barns of the Barns Engi-

\*Member of firm-The J. N. Chester Engineers.



GENERAL VIEW OF THE WHOLE TORRANCE SEWAGE DISPOSAL PLANT UNDER CONSTRUCTION

The sludge bed and humus tank with a traction-type clarifier and building over the sludge pump can be seen in the
foreground. The trickling filter is immediately behind the humus tank and the Imhoff tanks to the right of the trickling
filter and immediately back of the sludge bed. The mechanical coarse screen and laboratory building are located above
the Imhoff tanks. One of the institution buildings may be seen in the right background. The Torrance plant is designed
for a 500,000-gallon per day flow. The sludge bed is 29 ft. 4 in. by 42 ft. 9 in. with the concrete side walls 18 inches above
the sand surface, and the glass side walls 6 ft. high.

neering Company, who were the builders of the glass enclosure.

Smoke candles producing large volumes of smoke with very little heat were burned outside of the glass enclosures and the smoke was carried into the buildings by the entering air currents. The currents of air within the buildings were thus made visible by dense vellow smoke from the candles.

The tests were made under six conditions of ventilation as indicated by the diagrams of Figure 2.

It will be noted that with the inward opening sash in operation, there was a tendency to deflect the smoke currents toward the sludge surface in every case; whereas with this sash closed and the outward opening sash above operating, there was a tendency to short-circuit the air currents through the ridge sash, although there was some general diffusion of smoke throughout the interior of the sludge bed. In all of the tests the windward ridge sash remained closed, in order to facilitate measurement of air velocities at this point as they left the sludge bed. However, the observations made on the Greenwich sludge bed would indicate that the best drying results might be expected with both ridge sash open. The results are well illus-

trated by the photographs taken under the various conditions

Figure 3 illustrates the decided manner in which the smoke was deflected towards the sludge bed with the inward swinging sash open, and the windward ridge sash closed. This photograph applies to Test No. 1.

The manner in which the smoke diffused through the building in Test No. 1 is illustrated by Figure 4 taken a few seconds after the photograph of Figure 3. The smoke continues to stream along the bottom of the sludge bed in decided fashion.

Results of Test No. 4 are well illustrated by Figure 5, wherein it will be seen that the smoke streamed along the roof line in marked fashion.

The effect of having both side sash open on the windward side with the windward ridge sash closed, as outlined in Test No. 5, is illustrated in Figure 6. A single smoke candle was used in this case, a distance of 3 to 4 feet from the side of the enclosure. The anemometer will be observed in the bay at the extreme right of the photograph.

The tests were made with extremely low wind velocities in hot weather, the results of which would permit conclusions to be drawn to the effect that the air

currents illustrated by the sketches and the photographs would be intensified materially with increased wind velocities.

An attempt was made to calculate the number of air changes incident to each condition, but the equipment sufficient for this was lacking. Measurements taken with a single anemometer indicated approximately 18 complete air changes per hour under Condition 6, for instance.

Mr. Barns, since the Torrance tests, has made similar observations at Greenwich, Conn., and Lodi, N. J. The Greenwich enclosure is 40 ft. by 60 ft. in plan. The concrete walls extend 4 ft. 5 in. above the sand line, while the glass side walls are 4 ft. 8 in. high, with the lower sash fixed and the upper one opening outwardly. Thus the side ventilating sash is located 6 ft. 9 in. above the sand line. Ventilating sash is provided on both sides of the ridge.

The pertinent data taken during the Greenwich test are as follows:

Wind velocity—5.3 miles per hour.

Outside temperature—84.5 degrees Fahr.

Inside temperature—95.0 degrees Fahr.

Temperature difference—10.5 degrees.

Weather-bright sunlight.

Time of day-11:30 A. M.

"Apparent" number of air changes per hour—10.4.

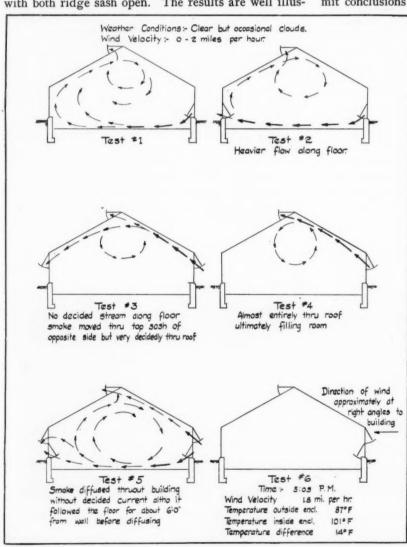
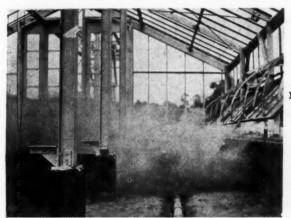
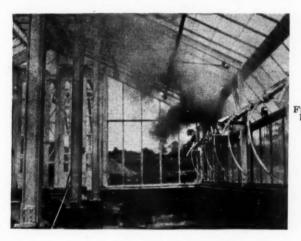
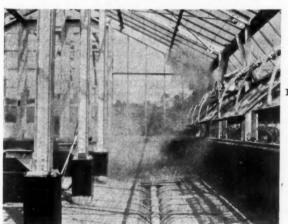


FIG. 2—DIAGRAMS SHOWING CONDITIONS OF VENTILATION DURING THE TORRANCE TESTS









The result obtained with the side sash open and the windward ridge sash closed is illustrated in the photograph, Figure 7. The smoke is to be seen streaming along the underside of the roof. The effect of having both ridge sash open in shown in the photograph, Figure 8, under which conditions the smoke was blown downward partly by the wind currents entering the enclosure through the windward ridge The heavy short-circuit of smoke along the roof was observed in all of the tests; also, that it required some time for the enclosure to become cleared of smoke. This was due, undoubtedly, to the lack of definite air currents at the lower levels within the enclosure. It was observed further that the best condition of air circulation was obtained in the Greenwich enclosure when all side wall and ridge sash were open.

The sludge bed at Lodi, N. J., is 40 ft. by 100 ft., with side sash opening outwardly. Ridge sash are provided on both sides. The wind velocity was 4 to 6 miles per hour and variable in intensity and direction. The inside temperature of the enclosure was 94 degrees Fahr. and the outside 83 degrees Fahr. It was impracticable to develop the number of air changes in the enclosure due to the varying direction of the wind.

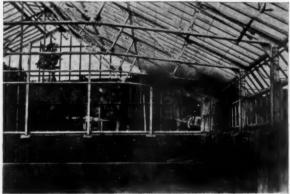
It will be observed that the photograph, Figure 9, shows fairly distinctly the usual short-circuiting effect of air currents due to the outswinging sash. The smoke will be seen in the middle of the picture following the roof sash as a light haze. Both ridge vents were open, as was the side wall sash to the windward. The effect of having both windward and leeward side sash open and both ridge vents open is illustrated in Figure 10, where the smoke will be seen diffusing through the building generally without positive currents of any sort unless it be a current along the roof toward the ridge sash.

The Lodi glass enclosure is similar to that at Greenwich excepting that it has but one row of side sash which opens outwardly. The observations show that best circulation was obtained with all side and ridge sash open, but there was an absence of definite air currents at the lower levels in this case, too.

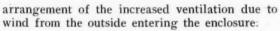
Definite results as to relative drying efficiencies could not be made available at Torrance until the plant is ready to dry sludge, but the observations so far made of air currents hold considerable promise due to the inward-opening side sash. In the design of the glass-enclosed sludge beds at New Lexington, Ohio, the writer's firm installed a blower and air ducts with a number of openings at the sludge line, so as to permit of withdrawal of the saturated air at such points and to induce greater currents of air towards the sludge. This plant has been placed into operation only recently, thus no data are available as yet on actual sludge drying. However, some generalizations are made possible by the tests as follows:

1. It has been demonstrated beyond question that, for a sludge bed enclosure of the simple double pitch roof type, the side wall sash should be hinged at the top to swing inward, thus deflecting the air currents to the areas immediately over the sludge bed. Since the vertical projected area of the opening of the side wall sash is greater in the case of the in-swinging sash than in the case of the usual out-swinging sash, greater advantage can be taken in the former









- 2. In sludge beds with outward opening side sash, best circulation of air is obtained with all ridge and side sash open.
- 3. In sludge beds with inward swinging side sash, best circulation of air should be obtained with all but the windward ridge sash open.
- 4. Glass side walls should be located as close to the sludge line as possible.
- 5. If side sash must be placed high above sludge line, improved ventilation is possible with blower fans and air ducts located near the sludge line, as a substitution for or adjunct to inward swinging side sash.

#### Sewage Disposal Plant for Rockville Center

Rockville Center, Long Island, N. Y., has installed a new sewerage system and sewage treatment plant at cost of about \$1,800,000, construction on which was begun in April and completed in November. The sewerage system consisted of about 55 miles of sewers ranging from 8-inch to 30-inch.

Of the total cost, about \$500,000 was spent on the sewage treatment plant, which has some unusual features. It provides for activitated sludge treatment, final sedimentation, natural sand percolation, separate sludge digestion and drying sludge on glass-covered





FIG. 9—LODI TEST—WINDWARD SIDE SASH AND BOTH RIDGE VENTS OPEN FIG. 10—LODI TEST—ALL SIDE SASH AND RIDGE VENTS OPEN

sludge beds. The digestion tanks have gas collectors and the gas is used for heating coils in the tanks to facilitate digestion of the sludge. The sand percolation beds are unusual in that they have no underdrains, the sewage seeping directly into the ground, which is sandy to a considerable depth.

#### Treated Water Supplies in New York State

A marked increase in the number of persons served by chlorinated or filtered water is shown in a pamphlet on public water supplies recently issued by the New York State Department of Health.

When supervision over public water supplies was commenced in 1906, about 6,000,000 persons were served, of whom only 700,000 were served by treated water. At the present time some 10,000,000 or more are served, over 9,000,000 of whom use treated water. Stated in another way, 85 per cent of the population of the state is served by public water supplies and 79 per cent receive treated water.

It is interesting also to note that of the 608 public water supplies of the state, 286 are from surface sources, 247 from ground waters and 75 from mixed surface and ground water sources. Of these, 376 are owned by municipalities and 323 are controlled by water companies or corporations.

Copies of this pamplet may be obtained from the Division of Sanitation, 23 South Pearl street, Albany.

# A Difficult Highway Embankment Job in North Dakota

Making a fill eighteen feet deep across sixteen hundred feet of muck with maximum depth of twenty-six feet under ten feet of water. Movement of muck displaced bridge abutments.

After two years of work, the contractor last spring finished a fill 1615 feet long across a lake with a bottom of muck, which muck was the principal cause of the apparently slow progress; weather and climate also contributing.

North Dakota State Highways 5 and 9 cross Upper Des Lacs, a trestle having been built from the ice during the winter of 1905-'06 for this purpose. This included a steel swing bridge with 125 feet span, about 400 feet from the eastern border of the lake. Many of the piles were spliced since the muck in the lake bottom reached a depth of 26 feet where the water was 10 feet deep. Almost every spring the ice pushed many of the piles out of position and broke some, and by 1920 it became evident that something must be done to maintain a crossing. There were objections to moving the location of the road, and it was decided to substitute a fill for the old trestle; and in 1927 a contract was let to Schultz Bros., of Bowbells, N. D., for a mile of road including this fill.

The fill was to be 1615 feet long, 28 feet wide on top, with side slopes of 2 to 1 above water and 3 to 1 below water. During the work it was decided to make the fill one foot higher and three feet wider. With an allowance of 40 percent for shrinkage it was estimated that 167,000 cubic yards of excavation would be required for the fill. The sides of the fill were to be protected from wave action by brush mat-

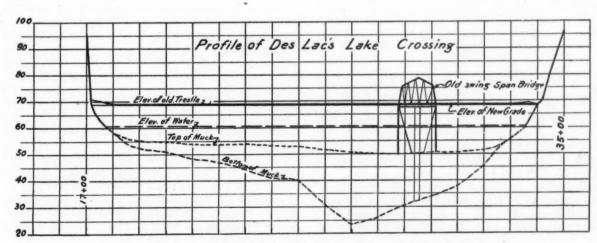
At each end of the swing bridge a line of 50-foot piles were driven extending thirty feet on each side at right angles to the center line. Immediately behind these at each end of the bridge was placed a curtain wall and a timber bridge seat, held in place by cables anchored to bents of the old trestle and new

bents braced together. To further hold the curtain walls and bridge seats in place, rock fill was placed against the outer or channel face of the curtain walls.

The contractor had intended to use a narrow-gauge railway and dump cars on the old trestle for making the fill, but there seemed doubt of the strength of the trestle to carry them and he built the fill out from the ends, using a bulldozer with a 10-ton Caterpillar tractor to push dumped material down the face of the fill.

Work was begun April 25, 1927, at the east end, wagons being loaded by a ¾ yard Bucyrus steam shovel and hauled to the dump by Caterpillar tractors. On May 10 a blizzard held up work for a week. When the fill had been carried 200 to 250 feet from shore, muck from the bottom appeared above the lake surface 80 to 100 feet away on each side, and soon after this appeared ahead of the fill, near the bridge abutment.

Fearing this would push the bridge seat and curtain wall out of place in spite of precautions already taken, four 3/4-inch cables were fastened to the piles of one bent and anchored to a deadman buried back in the fill. This held the muck for a time, but then the piles broke below the surface of the muck, which had risen all the way ahead to the abutment, and work was stopped while all the piles at the end of the bridge were anchored to deadmen. When, after resuming work, the fill had been advanced to within 50 feet of the bridge, the extreme wing piling moved 9 feet out of place, and the center piles, bridge seat and curtain wall about a foot, preventing opening the swing bridge; this in spite of 1300 cu. ft. of rock dumped in front of this piling, where the water was 10 ft. deep and the muck 14 ft. Filling here was



PROFILE OF CROSSING OF UPPER DES LAC'S BY STATE HIGHWAY

then abandoned temporarily to permit forcing the piling back by placing more rock against the face. Rock was added periodically throughout the season, piled 4 or 5 feet above the water line. It would remain stationary for a short time, then settle slowly or disappear over night. Ultimately a total of 9000 cu. yds. of rock was placed against the two abutments, and the bridge seat pushed back into place.

Meantime an attempt was made to continue the fill west of the bridge by dumping from its west end, but operating tractors, wagons and bulldozer on a bridge 18 feet wide was found to be impracticable, and work was begun from the west bank.

Here also the muck acted the same, but more so. The resident engineer of the Department of State Highways, A. S. Marean, describing the work in the "Bulletin" of the department, says: "At first a quaking, quivering mass of foul-smelling, dark gumbo appeared, being pushed up slowly but steadily as the fill grew, often being six feet above the water. It hardened and fissured on the surface as time went on. Those courageously inclined could walk over it. Old piling were snapped off below, carried forward like soldiers on parade by this irresistible black mass, finally toppling over to lie prone or disappear into the murky depths.

"As a rule, a narrow channel of water remained between the muck and fill, but now and then the mud would pile up and roll back on the dump. The muck directly ahead of the fill was so compact that the 10-ton Caterpillar tractor was run out where there was less than one foot of fill. This was done, not once but several times. These times were exceptional and not the rule. Very little settlement was noticed.

"The entire fill had to be raised one or two feet every week throughout the season. Some weeks no advance into the lake was made—it kept the outfit busy to hold what they had gained. During the night, longitudinal sections of the fill would crack off in lengths varying up to 100 feet. Settlement ranged from a few inches to 4 feet. Once a section covering 25 or 30 square feet of area along the center line dropped down three feet. This was in a part of the grade that had been constructed for some time. Each settlement spread the muck out more and more, the outer edge often being 125 feet from the side slope."

There were other troubles also. From April 25 to June 25 rain permitted only seventeen days of work; and the amount of real work the contractor was able to do during the entire season totalled only a few weeks. Two or three hours of hard rain meant the loss of as many days. On the other hand, a few days of dry weather made the dust unbearable and dangerous. Light sprinkling was of no effect in laying the dust, while a heavy application made the roadway slippery, which made it difficult to haul the dirt over the 7 to 15 percent grades. Finally it was found that spreading freshly excavated dirt over the dusty road and blading it off daily, sprinkling lightly with water, produced excellent results.

Still further trouble was caused by pockets of water and quicksand encountered in the cut high up on the slope of the hill. At times it was only with great difficulty that one wagon could be hauled by the tractor through this soft ground, some of it a bluish, rubbery clay. The shovel was taxed to advance 40

feet a day while taking out a strip 4 feet deep and 15 feet wide. Several times it had to leave the wet spots to allow the water and quicksand pockets to drain out.

As already stated, the embankment was protected against wash by brush mattress, of which 90,000 sq. ft. was used. Diamond willows and chokecherry brush were used for this, the former shipped by rail from the Missouri valley at Williston; the latter (used on the under-water portion of the mat) hauled twenty miles by truck. The mattress is similar to the revetment used by the War Department on the Missouri river, but of very close weave and thicker; the cherry brush making the thicker mat owing to its numerous small branches. The part of the mat intended for below the water was laid on the ice, and settled during the break-up last spring in good shape. Rock, gathered along the shore and hauled over the ice by horse sleds, was used to cover the mat, being laid along the edge of the mat and the interstices chinked with smaller stone, with a depth of one foot at the edge of the mat and two feet at the water line. Cribbing timbers were placed along the lower edge of the mattress. To secure the mat in place, a system of longitudinal and transverse cables was used, the latter passing under and over the mat and then through the embankment to the mat on the opposite

The embankment was completed last May and the road has been surfaced with gravel since then.

#### New York's Greenpoint Incinerator

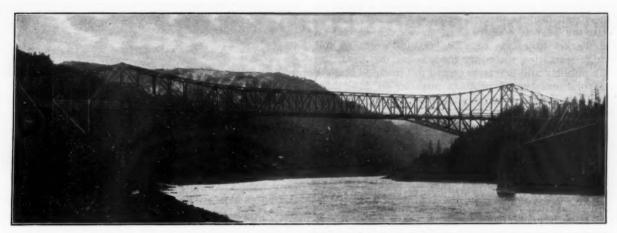
Operation was begun about September first of an incinerator of the Heenan type with a capacity of 500 tons of mixed refuse per day, located at Greenpoint, New York City. This is one of three plants of this type and size constructed by New York recently, one of which was completed early in the summer and the third of which is nearing completion.

Garbage is dumped into a long pit in the rear of the furnaces. Rubbish is dumped onto two belts from which the salable material is removed by men stationed five along each belt, the remaining rubbish being dumped into the ends of the garbage pit and from there distributed over the garbage. The mixed garbage and rubbish is fed to the furnaces by two 3.3-ton traveling cranes with 1½ cu. yd. grab buckets. These deposit it in square containers of 3 cu. yd. capacity, which feed it to the furnace, a sliding bottom being opened by means of a chain pull operated from the stoking room.

Forced draft of air preheated to about 400° to 500° F. is delivered to the furnace by fans with capacity of 15,000 cu. ft. per minute at 4½ inches pressure. The temperature in the combustion chamber is generally 1600° to 1800° F. and that in the chimney ten feet above the base about 675°. There are two chimneys 9 ft. inside diameter and 150 ft. high.

Ashes fall from hoppers into a sluiceway, where they are forced by jets to a pit, from which they are raised by a grab bucket and loaded onto scows.

Paper and rags recovered from the rubbish are pressed into 800 to 900-pound bales, and tin cans into 50-pound blocks, under a pressure of about 2000 lb. per square inch. The paper sells for 50 cents to \$1 per hundred pounds.



"BRIDGE OF THE GODS," A TOLL BRIDGE OVER THE COLUMBIA RIVER BETWEEN WASHINGTON AND OREGON, WHICH COST \$593,000.

## Present Status of Toll Bridges in United States

Regulation by Federal and State governments. Methods of financing privately and publicly owned bridges. Granting of franchises and financing are in a stage of development.

#### By P. K. Schuyler\*

There is at the present time invested or contemplated for investment in toll bridges, including both publicly and privately owned structures, an estimated amount of \$1,100,000,000. A tabulation of the number of toll bridges and toll bridge projects in the United States or on the International boundary shows the following conditions:

Numb	er of Toll	Bridges	
	In Oper- ation	Under Con- struction	Proposed
October 1st, 1927**	233	24	163
August 1st, 1929***	272	60	294
##Data from aumuon	has Darmana	Dublis Dande	

\*\*Data from survey by Bureau Public Roads.
\*\*\*Data from files of Federal Bridge Company.

In the interval from October 1st, 1927, to August 1st, 1929, 73 new toll bridges were placed in operation; but during the same period 34 toll structures were freed, thus making a net addition to the number of bridges in operation of 39. (In the above tabulation, a toll bridge is considered to be proposed when some definite steps have been taken regarding it, such as obtaining or making application for a franchise or organizing a company.)

The original source of power to build bridges was vested in the various individual states, from which source titles to land originate. The federal government, due to the commerce clause in the constitution which gives the government power to regulate commerce between states, acquired certain rights and powers of control and regulation over the building of bridges, and in 1906 Congress passed a general bridge act under the authority of which all bridges requiring federal consent are now constructed. For each bridge which is to be constructed over water that is navigable

in two states, an authorization in the form of a special act of Congress is required. The earlier authorizations granted by Congress (of which there are some 150 in existence) were perpetual franchises. Congress in 1926 and 1927 in general adopted the policy of granting authorizations with a recapture clause, so that after a twenty-year period the bridge might be purchased by public authorities subject to certain definite terms and conditions. In the last session of Congress this twenty-year period has been further reduced so that a number of recent authorizations allow recapture after the lapse of a five-year period.

The regulation of toll rates for bridges over navigable waters was delegated by the General Bridge Act of 1926 to the War Department. A considerable number of states in recent years have come to recognize toll bridges as a type of public utility and have passed legislation placing the regulation of service and rates of such bridges under the various state public service commissions. Pennsylvania is an example of a state

which has enacted such legislation.

The financing of toll bridge projects has been in the process of undergoing readjustment. It has been customary in the past to finance a toll bridge project usually by the sale of first mortgage and debenture bonds secured by the individual bridge and its income. However, there is at the present time a tendency, both with the states and with private interests, to group toll bridges together and put out securities of a holding company nature. Such consolidations or groupings are of a like nature to the development of holding companies in the field of other utilities. The State of Alabama recently sold \$5,000,000 worth of toll bridge bonds put out by the Alabama State Bridge Corporation, which is a public body set up by state

<sup>\*</sup>President, Federal Bridge Company, New York.

legislation to construct, own and operate a series of fifteen toll bridges in that state.

In the past few years there have been placed on the market in excess of \$230,000,000 worth of toll bridge securities, including those issued for financing both publicly and privately owned toll bridges. Among the total number of projects financed to date there have been some conspicuous failures, although the proportion of the failures is small in comparison to the total number of projects. These failures have been brought about in many instances because local enthusiasm for a bridge had been allowed to overweigh sound engineering judgment, and the consequence was that the bridge has been provided at the expense of the purchasers of the securities. It is advantageous to the traveling public to have a free bridge wherever the federal government, state or other political subdivision is financially able to provide it; but at certain locations, such for example as the crossing of the Hudson river at New York, it does not seem justifiable to expend funds collected from general state or federal taxes for an expensive bridge that would be used primarily by residents living in a restricted adjacent area. At such a location a toll bridge furnishes the logical solution, as it places a tax directly on the user rather than upon the public as a class.



ANTIOCH, CALIF., TOLL BRIDGE Built in 1925 by American Toll Bridge Co. at cost of \$1,585,000

The granting of franchises and the financing of toll bridges is at the present time in a formulative stage and it may be expected that within the course of the next few years there will be enacted a considerable amount of legislation by the federal and the state governments regarding toll bridges and that such legislation will tend to safeguard the interests of both the traveling and the investing public.

# Levee Construction Under Difficult Conditions

Using a combination of draglines and industrial railways operating on standard-gauge tracks, Igo and Boyce recently completed a section of levee near Alsatia, La., under difficult conditions caused by wet weather and high water. The work, which involved about 100,000 cubic yards, was a sub-contract from the T. T. Sweet Dredging Co., and was of emergency character in order to close the gap before high water. Work began on March 4, 1929, and was finished on

April 7, and was carried on at high speed, night and day.

feet long. On this was operated four 12-yard Western standard-gauge dump cars, usually in trains of 2 each. These were pulled by a Vulcan 8-ton gas locomotives. At the borrow pit, a 30-B Bucyrus dragline with a 11/4-yard bucket was used to load the cars. These were dumped into a pit along the toe of the levee and the material removed and placed on the levee by a 31/2-yard Monighan walking dragline, equipped with an 85-foot boom. This machine, travel-

> ing on the crown of the levee, handled out of the borrow pit, which usually contained 5 or 6 feet of water. The illustration shows the dragline, the cars dumping into the pit, and the wet conditions generally, which would have prevented work by almost any other kind of equipment.



MONIGHAN DRAGLINE TIPPING INDUSTRIAL CAR INTO DUMPING TRENCH.

# Slag in Bituminous Road Construction in the Southeast

By George J. Fertig\*

In the southeastern states, where frequently it is not economical, nor possibly advisable, to build the more expensive types of hard-surface pavement, basic blast furnace slag and bituminous binders have been used in building roads, particularly where local materials were suitable for base construction but not for wearing surfaces. The principal use of blast furnace slag in bituminous construction has been as the mineral aggregate in the wearing surface of bituminous macadam and in the surface treatment of water-bound stone macadam, chert, clay-gravel, sand-clay, top soil, shell and lime-rock roads, although large tonnages of slag have been used in bituminous concretes and in the binder course of sheet asphalt.

Crushed and screened slag used with bituminous materials has given good results largely because it is porous, tough and sharply angular. Its extra surface area allows additional locking facility and adhesion with the binding agent and consequently resists removal and dislodgement once mechanically bound under the roller. Chemically, it is of such a nature as to be inert to the action of all atmospheric agents and bituminous road binders.

#### BITUMINOUS MACADAM

Most of the bituminous slag macadam in the Southeast has been laid by the penetration method, using two or three applications of bitumen applied with pressure distributors and customarily three different sizes of crushed and carefully sized slag, the coarsest of which was uniformly graded between the allowable size limits and practically free of fines passing a 3/4-inch screen. The standard sizes used in this construction have been graded between 1½ inches to 2½ inches for a 3-inch wearing surface and from 3/4 inch to 1½ inches when thinner courses have been specified. For choke, 3/4-inch to 1/4-inch generally has been used, with finer aggregate vary-

ing between 34-inch to 10-mesh or 5%-inch to 10-mesh utilized for the seal coat.

Economic necessity some ten years ago was responsible for the development in Florida of an inverted form of penetration macadam. Florida possessed no mineral aggregate suitable for use in bituminous construction but was rich in lime-rock acceptable for base construction. In order to reduce the cost of road construction by building a thinner wearing surface using slag, with lime-rock for base, types

of penetration macadam were devised which made it possible to build more miles of better road with the money available. Marion County, using local limerock in 6 and 8-inch base, has completed approximately 181 miles of slag surface treated roads at an average cost of \$15,064 per mile.

#### SURFACE TREATMENT

Probably the widest use of slag for bituminous surface treatment is in the southern states, where 3245 miles of slag surface treated roads and streets are giving satisfactory service. Florida now possesses about 2945 miles of this low-cost pavement. Alabama, Georgia, South Carolina, Tennessee and Mississippi collectively have about 300 miles. The success of this type of wearing surface in Florida is attributable to very slight temperature variations, excellent sub-soil drainage and the fact that the limerock rolls to a base of remarkable smoothness. This type of bituminous surface is very economical, since construction requires only thirty to forty pounds of slag chips per square yard and it can be maintained indefinitely at low cost. The Georgia Highway Department has developed a "mixed on the road" method of reducing the cost and improving the quality of bituminous macadam. Using state forces and equipment, 33 miles of road were built between Waycross and Dupont using crushed slag in varying quantities per square yard and in several different sizes, with asphalt as the binding agent. The slag was mixed with cold asphalt on a clay-gravel base using a highway maintainer, with the result that the usual difficulty encountered by penetration methods in completely coating the aggregate was overcome. This construc-tion was carried out through 1926, 1927 and 1928 and greatly cut the costs of building bituminous macadam roadway.

To provide a more permanent type of surfacing



RIVIERA DRIVE, TAMPA, FLORIDA

A 24-foot roadway, with 6-inch base of compacted shell covered with a double surface treatment using No. 6 Birmingham slag.

<sup>\*</sup>Chemical engineer, Birmingham Slag Company.

for many of the sand-clay roads of northern Florida and Southern Georgia, careful treatment and selection of clays having provided excellent bases, special means of construction have been devised lately to provide a suitable bituminous wearing surface. In constructing the base, soils selected for very high stability were deposited 12 inches deep between form boards and compacted to from 8 inches to 8½ inches depth. (The red pebble soils of Georgia were used without mixture in that state.)

When the base had taken its firm set, a prime coat of asphalt was spread on the road surface, the amount and viscosity of the bitumen depending upon the nature of the soil being treated. Lime-rock bases required from .10 to .25 gallon per square yard of a 8-13 viscosity bitumen. Clay-gravel bases took .30 to .35 gallon of a 13-18 viscosity bitumen. Sandclay bases required about the same amount of a 13-18 or a 18-25 viscosity product depending upon the porosity of the material. This prime was allowed to penetrate for from twenty-four to forty-eight hours free of traffic; the road then was opened for from twenty to thirty days, weak spots re-primed and brought to a true surface by cold patching, and a seal coat consisting of slag and asphalt put on as the final surface. Asphalt of 180-200 penetration was applied hot at the rate of .4 to .5 gallon per square yard. Slag chips varying between the limits of 5/8-inch to 10mesh were spread and thoroughly rolled immediately with a 7 to 10-ton roller. Flor-

BITUMINOUS CONCRETE

condition.

ida has roads with this size of cover material which are seven years old and still in excellent

The indented surfaces of slag make it an excellent material for the asphaltic mix of a bituminous concrete, especially as it is free from dust coating, being washed after screening. More than one thousand miles of asphaltic concrete made of slag are giving good results in eighteen different states, some of these roads having been in service over fifteen years. Georgia has 28.5 miles of Amiesite pavement of slag construction, with twenty additional miles under contract for construction. There are 96 miles of Warrenite-Bitulithic pavement in the southern states made with blast furnace slag as the graded aggregate, Florida having 67.8 miles and Alabama, Georgia and Mississippi 28.2 miles. Southern sheet asphalt roads built with a slag binder course totals 278 miles. Thirty-nine miles of black base have been laid in Alabama and Georgia with blast furnace slag as the aggregate. "Tar-mac," a premixed bituminous concrete using slag as the coarse aggregate, has been used extensively in England for more than 60 years. In the United States the term "Slag-mac" is applied to this type of bituminous concrete, which was introduced some two years ago at Youngstown, Ohio, and has been used in Pennsylvania also.

#### Cold-Laid Asphalt for Street Patching in Cincinnati

By Edmund Johnstone\*

Present development in bituminous paving of modern roads is in the direction of using asphaltic material which can be laid cold; the latest advance in which is the introduction of emulsified asphalt for surface dressing. Prior to its use, a bituminous dressing of tar or asphalt, either hot or cold, was applied annually. In the case of cold applications, it was necessary to use a tar or asphaltic oil of a light consistency, or to liquefy heavier bitumens by the addition of volatile oils.

Research has been made into asphalt emulsions to develop an asphalt road surfacing material which would have the practical advantage over the hot methods of construction that it would not require complicated equipment, but nevertheless should be dense in structure and easily handled.

\* President Colprovia Roads, Inc.



LAYING THE LARGER AGGREGATE FOR AMIESITE SURFACE. FULTON COUNTY, GEORGIA



THE SAME ROAD, AFTER COVERING WITH FINE SLAG AGGREGATE AND ROLLING

In maintaining streets in Cincinnati, the highway engineers have adopted the method of repairing them in large sections. In the past, hot asphalt mixtures have been used; but during the past year they used "Colprovia" (a cold process pavement material developed and tested out in England over a period of years), in the form of an asphaltic concrete for the repair of roadways between trolley tracks, while for resurfacing large areas with a sheet surfacing they used the same material mixed with an aggregate which was entirely asphalt sand.

The asphaltic mixture was made in the city's hot asphalt plant, the only additional equipment necessary being an impact mill for reducing the hard asphalt to a fine powder. To the powdered asphalt which is the resultant was added a high-grade flux oil carefully selected so that it will combine entirely with it to produce a true asphalt cement of the required penetration. The speed at which the hard asphalt and the oil amalgamate can be controlled to a very considerable extent within limits, which permits storing the material for long periods and transporting it by rail without losing

its property of easy handling.

The aggregate (which must be dry and preferably at a temperature below 110°F.) was weighed in correct proportions and delivered to a mixer, and to it was added a filler (which is introduced as a protection against water action) in the same manner in which such filler is used in hot asphalt processes. These two, when mixed, were thoroughly coated with the flux oil, after which the powdered hard asphalt was added, such proportions of oil and asphalt being used as would give a mixture of the required penetration. the hard asphalt had been evenly distributed throughout the mass, the material was ready for laying.

It was transported to the roads in trucks and was spread on the prepared foundation in the ordinary

manner.

The asphaltic concrete approximated in appearance that of hot asphaltic products of similar grading but it was noticeably easier to handle and behaved well under the roller. However, the chief interest in this work centered on the sheet mixture, which was laid over considerable areas on Harrison Avenue, where the old hot-asphalt pavement had been burned off to a considerable depth for its reception. The cold mixture was handled with ease. The flux oil (of which a slight excess was put in the mixture) readily fluxed the surface of the existing pavement and thus not only ensured an intimate bond between the new and the old,



LAYING COLPROVIA ON HARRISON AVE., CINCINNATI

but also livened up the asphalt of the old pavement and counteracted the deteriorating effect of the burn-The material was consolidated with an ordinary road roller and the road was opened to traffic at once.

#### Comments on "Build and Be Gone"

We have received the following discussions of the paper entitled "Build and Be Gone," by Henry W. Taylor, in the November issue of Public Works:

This paper, which emphasizes the great importance of providing for effective operation of sewage treatment plants, deserves careful consideration by both consulting engineers and municipal authorities. Too often in the past, sewage and municipal authorities. treatment plants have been designed without due considera-tion to factors of operation. There may be temporary intertion to factors of operation. There may be temporary interest on the part of municipal authorities and the populace in campaigns to raise funds with which to construct such plants but too often a change in personnel of the municipal boards has diverted attention elsewhere and the plants are soon neglected by the officials in charge. Another important factor tending to encourage such neglect is that the construction costs are borne by bond issues but that often no provisions are made for operation from current tax receipts in the municipal budget.

Disposal plants unfortunately are designed at times without due regard being given to problems of operation, although there is the distinct tendency now to utilize labor saving machinery and devices which will tend to improve operation. There still remains the great necessity for designing engineers to give consideration to the quality of the sewage to be treated, with special reference to the presence or not of industrial wastes, and for them to also allow for ground water infiltration when such occurs in existing sewerage systems. There are instances where this has not been done, with the result that the organic load may be equivalent to that from a much larger population, or the sewage flow in wet weather

may be two or three times the dry weather flow.

The remedies for these undesirable conditions need careful consideration. There is no question but that, as Mr. Taylor states, consulting engineers should be retained by the municipalities to operate new sewage treatment plants until satisfactory operating conditions exist and until a local operator is trained. In case of the smaller municipalities, the designing engineer should be retained as a supervising operator, or a technically trained operator of some nearby large sewage treatment plant should be retained as supervising chemist or

The trend of organizing state sewage works operators' as-sociations, as members of the Federation of Sewage Works Associations, is very significant and hopeful. Standardizing problems of design and operation and stimulating and intructing the operators of sewage treatment plants should

follow this development.

It is felt that the Sewer Rental Law of the State of New York provides in a very satisfactory manner funds for the operation of sewage treatment plants. In brief this sewer rental law provides for the collection of special funds by municipalities from property owners connected to sewerage systems, according to an equitable arrangement, and these funds must be used for the maintenance and repair of sewerage and sewage treatment works. It is felt that, with such definite funds available, it will soon be uncommon for one to have the difficulty experienced by Mr. Taylor and others in finding sewage treatment plants of their design, because of the rank growth of vegetation at the neglected site.

Charles A. Holmquist, Director, Division of Sanitation

New York State Dept. of Health.

We believe that this article expresses a need which is too often lost sight of, that is, many times after sewage works are installed they are allowed to rapidly deteriorate owing to no provision being made for adequate supervision after construction has been completed.

It seems to us that, if possible, provision should be made, for such times as are necessary, to teach local operators how to conduct a plant and how to keep it in efficient operation.

Elmer W. Campbell, D.P.H., Director, Division of Sanitary Engineering, Maine State Dept. of Health.

# More Money for Public Improvements in 1930

The following is based upon United States Census figures for cities of thirty thousand population and over. While it does not include small cities nor the great expenditures by states and counties, it gives an indication of trend of outlays following depressions in stock prices.

IN 1908, the year following the money panic when prices of stocks tumbled, the outlay for public improvements by cities of 30,000 and over in population was increased to \$41,500,000-from \$155,500,-000 in 1907 to \$197,000,000.

The next big drop in stock prices occurred in 1921. From the high level of 1919 to the low

up jumped to \$400,280,000 from \$226,895,000 in

in 1921 the average

price of stocks decreased about 43%. In

1922 the year follow-

ing this depression in

stock prices the outlay

for public improvements

by cities of 30,000 and

1921.

#### President Hoover Says:

"The Federal Government will exert itself to the utmost within its own province and I should like to feel that I have the cooperation of yourself and the municipal, county and other local officials in the same direction. be helpful if road, street, public building and other con-struction of this type could be speeded up and adjusted in such fashion as to further employment.

Nov. 23, 1929.

Since then the trend has been steadily upward until in 1927, the latest figures available, the amount invested in public improvements by the same cities was \$755,541,000.

The accompanying charts tell a more complete story.

We have been told during the past year or two by some economists that precedents no longer applied and it seems that some people acted upon that theory and lost their shirts.

While no predictions are infallible the chances are that more money will be expend-

ed by cities, states and counties for public improvements in 1930 than in 1929.

#### PAYMENTS FOR OUTLAYS By Cities of 30,000 and Over

These are the sums expended for permanent improvements-Highways, Water Supply, Sewerage, etc.

					9 .
1908		\$130,944,000.00	1917		.\$204,596,000.00
1906		135,496,000.00	1918		201,905,000.00
1907	7	155,394,000.00	1919	************************	178,538,000.00
1908	3	197,184,000.00	1920	no census reports published	
1909		189,665,000.00	1921		. 226,895,000.00
	)		1922		400,280,000.00
			1923		420,788,000.00
			1924		529,247,000.00
			1925		645,037,000.00
1914	no census reports published		1926		643,027,000.00
		239;630,000.00	1927		755,541,000.00

From U. S. Bureau of Census "Financial Statistics of Cities."

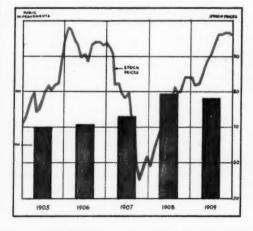
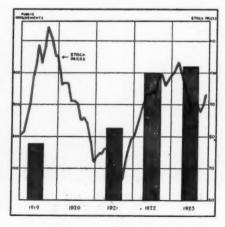


CHART 1. Steadily increasing expenditures for public improvements not affected by collapse of stocks in 1907.

CHART 2. Enormous increase between 1919 and 1923 despite reaction in stock market in 1921.



# RECENT LEGAL DECISIONS

COMPENSATION FOR LAND CONDEMNED FOR PUBLIC ROAD

Two elements enter into the question of remuneration to a party whose private property is condemned for a public road, namely, just compensation for the land actually taken, and a fair recompense for damage to the residue of the tract, beyond the peculiar benefits, if any, to be derived in respect to the residue of the land from the road to be established. County Court of Calhoun County v. Force (W. Va.) 146 S. E. 530.

# STATUTE PROVIDING FOR ROAD SYSTEM INTENDED IDENTITY OF EXISTING ROADS TO BE MAINTAINED

The South Carolina Supreme Court holds, Boykin v. State Highway Department, 144 S. E. 227, that the language of the act of 1924, providing for a state system of highways, and designating the routes to be followed, indicates that the Legislature intended the state highway commission, in constructing the highways on the designated routes, to maintain the identity of the then existing roads; and the department, being an administrative body, created by the Legislature with certain fixed duties to perform, could not disregard the express instructions of the Legislature.

#### CLAIMS FOR BORROWED MONEY TO PAY FOR LABOR AND MATERIAL NOT WITHIN ROAD CONTRAC-TOR'S BOND

The Minnesota Supreme Court holds, First Nat. Bank of Chisholm v. O'Neil, 223 N. W. 298, that a bank, which by agreement with the contractor, advances money to pay checks for labor and material used in the construction of a highway, is not subrogated to the rights of the laborers and materialmen whose claims were paid, nor entitled to recover such advances on the contractor's bond, since claims for borrowed money are not within the condition of the bond.

#### TOWN HELD NOT LIABLE ON BOAD-WORK CONTRACTS

The Illinois Appellate Court holds, Illinois National Bank v. Town of Bois D'Arc, 243 Ill. App. 587, that a bank which was not an innocent purchaser of road-work warrants could not collect them from a town for whose benefit they were issued by the highway commissioner, the town receiving no consideration for the warrants, which were not issued for a purpose for which the town might become indebted under the Illinois statute.

#### INVALID ROAD-WORK CONTRACT

The Illinois Appellate Court, Arnold v. Village of Ina, 244 Ill. App. 239, holds that a village board in Illinois can only create a liability against the village upon a yea and nay vote entered on the journal of its proceedings. The creation of a liability against a village in any other manner is expressly prohibited by the statute. The fact that the village received the benefit of road work done under order of the president of the board would not, it is held, allow the con-

tractor to recover from the village. The contract, moreover, if otherwise valid, would be invalid unless an appropriation had first been made for it.

#### RIGHT OF ROAD CONTRACTOR'S SURETY TO CONTRACT PRICE ON COMPLETING CONTRACT

The Alabama Supreme Court, Citizens' Bank of Guntersville v. Pearson, 116 So. 350, holds that a road building contract, which included the plans and specifications, the latter of which, by appropriate reference, included the bond given by the contractor's surety for the due prosecution and execution of the contract, was but one transaction, and these undertakings, when duly executed, were considered together, or were necessarily and materially related to each other; and where the surety completed the work on the contractor's default, at the expenditure of a large sum of money, it was held entitled, by the contractor's assignment at the inception of the surety-ship, the express terms of the bond, and the principle of subrogation, whereby a surety who is compelled to complete his principal's undertaking becomes entitled to receive the contract price in full, to the amount payable on completion of the work as against a bank which had loaned money to the contractor.

#### QUESTION OF BENEFIT FROM PUBLIC ROAD

If a public road will be a benefit to the county as a whole, or to any substantial part of the county where it may be located, the failure of the road to benefit either directly or indirectly the property of individuals situated in some other portion or portions of the county would not prevent the road from being a legitimate county purpose, for which the county, a constitutional unit, could levy an ad valorem tax on all the property in the county. Jackson Lumber Co. v. Walton County, Florida Supreme Court, 116 So. 771.

#### ROAD CONTRACTOR'S BOND—GASOLINE, OIL AND GREASE FOR EQUIPMENT

The Kansas City Court of Appeals, State v. Lyle, 5 S. W. (2d) 453, holds that gasoline, oil and grease used by a highway contractor in the tractors and other mechanical contrivances on the job, are covered by a contractor's bond under Mo. Rev. St. 1919, § 1040, for the payment of material used in the work.

#### CONTRACTORS' BONDS—RENTAL OF EQUIPMENT, REPAIRS, ETC.

The Alabama Supreme Court, Union Indemnity Co. v. State 218 Ala. 132, 118 So. 148, holds that rentals of equipment used in the construction of a bridge were within a road contractor's statutory bond under Ala. Code 1923, § 1328, securing claims for labor or material. The court mentions as states holding that rental of equipment is not within the terms of a contractor's bond, Iowa, Maryland, Nebraska, Oklahoma, and Wisconsin, and as holding that such statutory bonds are broad enough to include such claims, California, Kansas, Minnesota, Oregon and Washington.

On a rehearing of the case it was held that repairs of a hoisting engine, necessitated by an accident, and freight on the return of the equipment to the contractor, were not within the bond.

#### EXCESS CONDEMNATION OF LAND FOR WIDENING STREET

The Circuit Court of Appeals, Sixth Circuit, City of Cincinnati v. Vester, 33 F (2d) 242, takes it to be settled law that the due process clause of the federal Constitution applies to a state and all its agencies; that condennation of land for a non public use is a denial of due process of law; and that whether the use is public or private is a judicial question, which is sometimes difficult of solution. The court holds that the provision of the Ohio Constitution, art. 18, § 10, that a municipality in acquiring property for public use "may, in furtherance of such public use," appropriate or acquire an excess over that actually to be occupied by the improvement, and may sell such excess with such restrictions as "shall be appropriate to preserve the improvement made," means in furtherance of the normal use to which the property that is occupied by the improvement is devoted. It does not mean that a city may, in condemning a strip of land for the purpose of widening a street, condemn additional area adjacent to the strip for the purpose of selling it at a profit and paying for the improvement.

#### TEST OF PRUDENT CONSTRUCTION OF ROAD NOT AMOUNT OF WATER THROWN OFF BY DRAINAGE

In an action for damages caused by imprudent drainage of a road and for damage from rocks thrown on plaintiff's farm in the construction of the road, the Kentucky Court of Appeals held, York v. Pike County, 11 S. W. (2nd) 712, that the prudent construction of the highway did not turn on the quantity of water thrown on the plaintiff's farm, but on what was necessary to properly and prudently drain the highway, and if it was necessary that the drainage system should have been arranged as it was and the farm was damaged by such arrangement, plaintiff had been paid for such damage in the condemnation proceedings.

#### LIABILITY OF MUNICIPALITY FOR COLLECTING SUR-FACE WATER IN VOLUME AND CASTING IT UPON ADJACENT PROPERTY

The St. Louis Court of Appeals, York v. City of Louisiana, 12 S. W. (2d) 518, holds that a petition which alleged that the municipality, in grading and paving a street, removed tile and filled in a cobblestone gutter, thereby collecting the surface water in the gutter and diverting it and casting it in collected form with great force and volume onto plaintiff's property stated a cause of action within that class of cases wherein municipal corporations are held liable where, in the construction of its streets, it collects surface water out of its natural course by means of drains or conduits and causes the water thus accumulated to be discharged in a body upon adjacent property. The court said: "It is one thing to cast off surface water, as a consequence of the grading of a street, and quite another thing to change the natural flow, gather it in artificial channels, increase the volume of water, and cause it to flow upon private property in an increased volume.'

#### STATUTORY REQUIREMENTS AS TO ADVERTISE-MENT FOR BIDS

The Kentucky Court of Appeals holds, Wilson v. Blanton, 11 S. W. (2d) 127, that where a statute authorizing work on sidewalks to be ordered paid by the abutting owners provided for advertisement for bids, but did not prescribe any particular form of advertisement, advertisement in a newspaper at the county seat was sufficient. The specifications were not required to be a part of the advertisement if they were available to prospective bidders. A change in the specifications after submission of bids but before any bid was accepted was not a defense in a suit to enforce the contractor's lien against abutting property, since the contractor alone was in position to complain if the amendment required additional work.

#### BILLBOARD NOT BUILDING WITHIN FIRE LIMIT ORDINANCE

The Mississippi Supreme Court holds, Town of Union v. Ziller, 118 So. 293, that a municipal ordinance, prohibiting the construction of buildings made of sheet iron, wood or other combustible material within a designated fire district, being restrictive of the rights of owners of private property, must be strictly construed. Bilboards, consisting merely of thin walls with a sheet iron surface over a wooden framework, with supports to keep the boards from falling, were held not "buildings" within the meaning of such word used in Hemingway's Code 1927, § 6788 authorizing such an ordinance.

#### CONTRACTORS' BONDS—DEBTS INCURRED BY SUBCONTRACTORS

The Alabama Supreme Court holds, Pettus v. Dudley Bar Co., 218 Ala. 163, 118 So. 153, that a contract between a state and a bridge contractor by which the contractor agreed to pay for all material used, and gave bond guaranteeing such payment, was binding and enforceable against the contractor's surety as well as against the contractor, although the debt for labor and material was incurred by a subcontractor personally or primarily liable therefor, irrespective of the nature of the contract with the subcontractor, where such last mentioned contract recited that it was to become a supplement to the contract between the state and the bridge contractor; the word "supplement," as here used, extending or making applicable the original contract.

#### DISPOSAL OF RETAINAGE UNDER PUBLIC WORKS CONTRACT

The Mississippi Supreme Court holds, Union Indemnity Co. v. Acme, etc., Metal Works, 117 So. 251, that where a contract for the installation of a heating and ventilating system in a high school authorized the architect in his discretion to withhold a percentage of the contract price, the surety could not recover against the board of education the amount of such retainage as it was required to pay to materialmen under the terms of the board. An agreement of the architect selected by the board of education with materialmen to withhold funds due the principal contractor to the amount of their claims was held not binding on the board, since the municipality cannot be bound by the act of the architect outside of the contract.

### Engineering Societies

Jan. 11-18—AMERICAN ROADBUILD-ERS' ASSOCIATION. Annual Conven-tion and Road Show, Atlantic City, N. J. C. M. Upham, Director, National Press Building, Washington, D. C.

Jan. 20-23 — NATIONAL CRUSHED STONE ASSOCIATION. Annual Convention of Christian 1

STONE ASSOCIATION. Annual Convention at Cincinnati, O.

Jan. 28-30—NATIONAL SAND AND
GRAVEL ASSOCIATION. Annual Meeting at Memphis, Tenn.

Feb. 18-19 — PENNSYLVANIA AS-SOCIATION OF PLANNING COMMIS-SIONERS. Fifth Annual Conference at Easton, Pa. L. J. Buettner, Secy.-Treas., City Hall, Johnstown, Pa.

City Hall, Johnstown, Pa.

Feb. 19-21—ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES. Annual Convention at
Syracuse, N. Y. A. Lee Grover, Secy.,
State Highway Comm., Trenton, N. J.

Feb. 25-28—Fifth Annual SOUTHWEST
ROAD SHOW AND SCHOOL. Wichita,
Kans. F. G. Wieland, Mgr., Exposition
Bldg., Wichita, Kans.

April 14-19—NATIONAL FLOOD CON-

April 14-19—NATIONAL FLOOD CONTROL CONGRESS. Memphis, Tenn. R. E. Logsden, Chamber of Commerce, Chisca Hotel, Memphis, Tenn.

#### ARBA Convention and 1930 Road Show

The preliminary programs for business sessions and entertainment of delegates to the American Road Builders' Association convention and road show at Atlantic City, January 11 to 18, offer something of interest for everyone connected with road building.

From the time the distributors and manufacturers have their preview of the show on Saturday, January 11, until the final business and executive committee meetings end on Friday, January 18, the program is full.

Sunday, there will be a reception and tea in honor of Pan American diplomats, many of whom are going up from Washington, the Pan American delegations and distinguished visitors from foreign countries.

Monday, President Frederic A. Reimer will open the Road Show with appropriate ceremonies prior to the general session.

Registration will take place during the forenoon, also. The Road Show will be closed during the general session, Monday, and again on Wednesday morning.

A luncheon Monday noon will be followed by the organization of a Pan American finance committee. In the afternoon sessions for city officials, county highway officials, contractors and the lien law committee will get under way.

The Pan American division will meet late Monday at Pan American headquarters in the Ambassador Hotel.

The committees on subgrades and pavement bases, municipal airports and grading will meet Tuesday morning and the city, county and contractors'

groups will meet again Tuesday after-

The Pan American delegates will officially visit the Road Show Tuesday morning.

Wednesday morning and afternoon the general sessions will mark Pan American day, with speakers from most of the Latin nations, who will tell of road building progress. The city and county groups and the new location committee will meet separately in the after-

A luncheon is scheduled for Wednesday noon. The guests will be professors of engineering from many of the leading universities and technical schools, and this group will organize an educator's section or committee which should be of great value to the educational purposes of the association.

The popular equipment and finance committees will assemble Thursday morning, with national authorities on both subjects presenting papers of intense interest and value, followed by general discussion of the committee problems.

State and county highway officials will meet at luncheon Thursday. The city and county divisions and the grade crossings committee will meet in the afternoon.

Dr. Herman Velarde, Ambassador E. and P. of Peru to the United States, and Senor Don Orestes Ferrara, Ambassador E. and P. of Cuba, will be among the international celebrities who will be guests of the Association at the mammoth Road Builders' banquet on Wednesday night and the International Ball, Thursday night.

W. A. Van Duzer, assistant chief engineer, Pennsylvania Department of Highways, Harrisburg, Pa., has been nominated for the presidency of the American Road Builders' Association for the year 1930-31. Other official nominees chosen by the committee headed by W. B. Catchings, Raleigh, N. C., were:

Vice-Presidents: J. R. Draney, Natural Rock Asphalt Corporation, Louisville, Ky.; Henry G. Shirley, State Commissioner, Highway Richmond. Va., and a Past President of A. R. B. A.; S. F. Beatty, president, the Austin-Western Road Machinery Co., Chicago, Ill.; Samuel Hill, honorary life president, Washington State Good Roads Association, Seattle, Wash., and A. R. B. A. Past President.

For treasurer, the committee again named James H. MacDonald, consulting road and paving expert, New Haven, Conn., a founder and past president of the association, who has been treasurer many years.

Directors for three-year terms ending in 1933 were nominated as follows: C. M. Babcock, Minnesota State Commissioner of Highways, St. Paul, Minn., and an Association past president; T. H. Cutler, Chief Engineer, Missouri State Highway Commission, Jefferson City, Mo., who has had charge of the completion of a \$100,000,000 bond issue road program; H. J. Kaiser, Oak-

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# A Reduction in Long Distance Telephone Rates

An Advertisement of the American Telephone and Telegraph Company

ON JANUARY 1, 1930, there is effective a reduction in various long distance telephone rates in the Bell System which on the present volume of calls means a saving of more than \$5,000,000 a year to the telephone-using public in the United States. This is the fourth reduction in long distance rates within a little more than three years. On October 1, 1926, they were reduced by \$3,000,000. On December 1, 1927, a reduction of \$1,500,000 went into effect. On February 1, 1929, there was a reduction of \$5,000,000.

THESE REDUCTIONS are in accordance with the aim of the Bell System to continue to furnish the best possible telephone service at the least cost to the public. Earnings must, of course, be sufficient to permit the best possible telephone service at all times and to provide a reasonable payment to stockholders with an adequate margin to insure financial safety. Earnings in excess of these requirements will either be spent for the enlargement and improvement of the service, or the rates for the service will be reduced. This is fundamen-



tal in the policy of the management.

land, Calif., whose paving company is building a large portion of the Central Highway of Cuba; W. M. Kinney, general manager, Portland Cement Association, Chicago, Ill., who has been active in the highway industry for years; Wm. P. McDonald, Flushing, N. Y., whose construction company is operating in New York, Chicago, Florida and Canada; George F. Schlesinger, general manager, National Paving Brick Manufacturers' Association, Washington, D. C.; and John G. Townsend, Jr., United States Senator from Delaware, former noted highway builder.

#### Tennessee Society of Engineers

Organization of the Tennessee Society of Engineers preceded the election of Rutledge Smith of Nashville, general agent of the Tennessee Central Railway, as president and the selection of men from Knoxville, Memphis and Chattanooga to fill other offices of the new body when engineers of the state met at Nashville, Nov. 23.

Election of officers was a feature of the night meeting. During the day the group visited Nashville's new filtration plant, heard talks on flood control and other subjects Friday afternoon and concluded the meeting with a dinner that night.

Other officers follow: N. W. Dougherty, Knoxville, vice-president; F. B. Ragsdale, Memphis, secretary, and C. A. Betts of Chattanooga, treasurer.

#### American Water Works Association Rocky Mountain Section

The next annual meeting of the Rocky Mountain Section, American Water Works Association, will be held in Denver, February 13 and 14, 1930. The headquarters hotel will be announced later.

The program committee consists of Burton Lowther, Chairman, Colorado Building, Denver; Paul S. Fox, care of State Bureau of Public Health, Santa Fe, New Mexico; and H. L. Warner, 1453 Wazee Street, Denver. They are arranging an interesting and instructive program of technical water works papers, inspection trips, and entertainment features. Already two large manufacturing concerns have offered to show motion pictures depicting the manufacturing and testing of their products. The Inspection Department of the Associated Mutual Fire Insurance Companies of Boston has indicated a desire to send a special representative to talk on "Current Practice Regarding Cross Connections." A special request is being made to the Manufacturers' Association for exhibits of water works equipment, recently declared taboo at Section meetings except by special permission.

#### Association of Highway Officials of the Northeastern States

At the regular meeting of the Board of Directors held in Boston the election of officers for the ensuing year was held. The following are officers for 1930: Samuel Eckels, Chief Engineer, Pennsylvania State Highway Department, Harrisburg, president; George H. Henderson, Chief Engineer, Rhode Island Board of Public Roads, Providence, vice-president; A. Lee Grover, secretary and treasurer.

The Board of Directors adopted a resolution to be forwarded to the family of Stoddard B. Bates, expressing regret at the untimely death of Mr. Bates.

At the above meeting, the Board determined to hold the Sixth Annual Convention in Syracuse, New York, on February 19th, 20th and 21st, 1930. The convention headquarters are to be at the Hotel Syracuse. R. B. Traver, County Superintendent of Highways of Onondaga County, New York, was appointed as a committee to keep in close touch with the matter of hotel reservations.

It is the intention to have exhibits in connection with the convention. These exhibits will be placed on the main floor in the lobby and in the foyer and small ballroom on the tenth floor immediately adjacent to our meeting room.

Arthur W. Brandt, Commissioner of



HAMMERED and tossed by the North Irish Sea lies a bell-buoy off the Mull of Cantyre, Scotland. The British tars say that it has never been replaced, in their memory. They speak in hushed whispers, "It is bewitched," and for luck tug at their ears as they pass.

Of course the buoy is not bewitched. Its expensively coated exterior resists the corrosive action of salt water, making replacements unnecessary. Doubly braced inside with steel, doubly flanged, and triply riveted, it is strong enough to stand the buffeting of waves. A marvel of marine engineering.

# Hammered by the sea for generations Bewitched the sailors say



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in a bell-buoy, stresses strength and resistance to corrosion. For example, the strength of the Hersey disc piston is such that it will withstand the tremendous blows of water hammer for twenty years and more. As the Hersey Disc Meter is dip-tinned, it is corrosion proof. It is easily cleaned. Hersey Water Meters' inherent strength and accuracy are worth investigating. Reputation makes the initial sale of Hersey Water Meters. Performance keeps them sold!



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Dallas, Tex., 402 Praetorian Bidg.; Chicago, Ill., 10 So. LaSalle Street; San Francisco, Cal., 690 Market Street; Los Angeles, Cal., 450 East Third Street.

Highways of New York, has been appointed as chairman of the program committee. The other members of the program committee are John A. Macdonald, State Highway Commissioner of Connecticut, and F. E. Everett, Commissioner of Highways of New Hampshire.

#### Purdue Annual Road School

The sixteenth Annual Road School will be held at Purdue University, Lafayette, Indiana, January 20 to 24, 1930, under the direction of the Engineering Extension Department and the School of Civil Engineering. Cooperating will be the Indiana State Highway Commission, the Indiana County Highway Superintendents' Association, the Indiana County Surveyors' and County Engineers' Association, the City Street Commissioners' Association of the State of Indiana and the Highway Materials and Equipment Association.

W. A. Knapp, professor in charge, Engineering Extension Department, and Ben H. Petty, Associate Professor of Highway Engineering, Purdue University, will be in charge.

(Other "Engineering Societies" on page 52)

#### Personals

Maurice J. Lonergan has been appointed sanitary engineer of the Colorado State Board of Health.

Waldo W. Towne has been appointed director of the division of sanitary engineering of the South Dakota State Board of Health.

J. J. Hartley has been appointed chief engineer of the Link Belt Company's Pershing Road plant at Chicago. His brother, W. L. Hartley, has been appointed to succeed him as manager of Foundry Equipment Sales.

W. E. Rosengarten, who has been with the Asphalt Association, New York, as traffic engineer for a number of years, has joined Day & Zimmerman, consulting engineers, 112 North Broad Street, Philadelphia, Pa.

Edgar Jadwin, lieutenant - general U. S. A. and unil his recent retirement chief of engineers, has been employed as consulting engineer by the New Jersey Meadow Commission for the development of the extensive meadow area of that state.

John L. Mason, formerly sanitary engineer for the Water Works Supply Co., San Francisco, Calif., has become sewage research engineer for the Hardinge Company. Mr. Mason has had extensive experience in the sanitary field, having personally worked on the design or manufacture of a large part of the mechanical equipment installed in recent sanitation plants in the far west. Mr. Mason collaborated in the development of the "Warco" Aerator for the activated sludge treatment of sewage.

Howard G. Wright, formerly chief engineer of the North American Cement Company, Catskill, N. Y., has joined the staff of the Hardinge Company, York, Pa., as research engineer in the Cement Machinery Department. Mr. Wright will devote a large part of his time to working up engineering data for the various classes of Hardinge equipment used in cement plants.

Alexander L. Schuhl, manager of the Philadelphia Office of the Independent Pneumatic Tool Company, died suddenly, of pneumonia, on October 20th after an illness of only a few days. Mr. Schuhl was born in Philadelphia May 25, 1884. He had been connected with the company since 1917.

#### Civil Service

The United States Civil Service Commission announces the following open competitive examinations.—

Junior Patent Examiner.—Applications for junior patent examiner must be on file with the Civil Service Commission at Washington, D. C., not later than February 18, 1930. The examination is to fill vacancies in the Patent Office, Washington, D. C. The entrance salary is \$2,000 a year. Higher-salaried positions are filled through promotion.

Assistant Inspector (Radio Enforcement).—Applications for assistant inspector (radio enforcement) must be on file with the Civil Service Commission at Washington, D. C., not later than January 21, 1930. The examination is to fill vacancies in the Field Service of the Department of Commerce throughout the United States, including Hawaii, Alaska, and Porto Rico. The entrance salary is \$2,400 a year. Highersalaried positions are filled through promotion

The duties of the assistant radio inspector will be primarily to assist the radio inspector in the enforcement of the Radio Act. The assistant radio inspector will be required to inspect radio equipment on vessels and at land stations, which involves the carrying of 30 or 40 pounds of testing and measuring instruments; to make high frequency and field intensity measurements; to assist in the examination of radio operators, and to perform such office work as is required. The performance of these duties will involve considerable traveling, for which necessary traveling expenses will be allowed.

Competitiors will be rated on theoretical and practical questions on radio and electrical engineering, and on their education, training, and experience.

Information.—Full information may be obtained from the United States Civi! Service Commission, Washington, D. C., or the Secretary of the United States Civil Service Board of Examiners at the postoffice or custom-house in any city.

#### **Trade Publications**

Open Roads at Low Cost.—The Trackson Co., Milwaukee, Wisc., has published an illustrated folder covering snow removal.

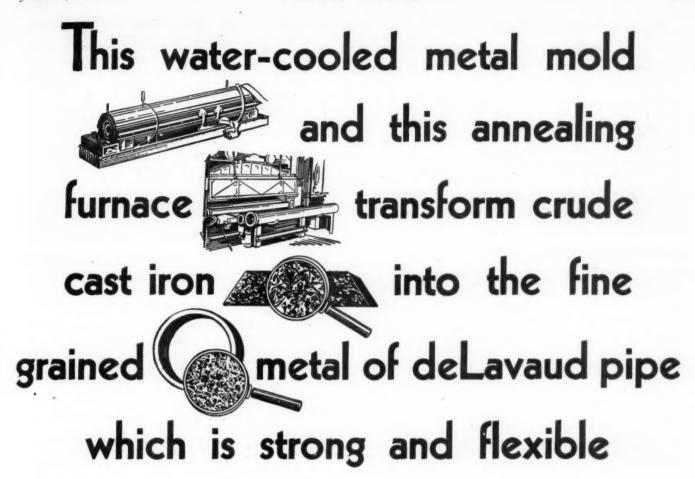
Testing.—A booklet issued by the Pittsburgh Testing Laboratory tells of the variety of inspection and testing services offered by them, and points out the advantages of such service.

Mixer Heating Equipment.—Littleford Bros. have just published a new bulletin on Winter Heating Equipment that gives a complete description of their concrete heating units for both tilting and non-tilting mixers. It can be obtained through this magazine or by writing direct to Littleford Bros., 452 E. Pearl Street, Cincinnati, Ohio.

Rotary Car Dumpers.—Link-Belt Company, of Chicago, has issued a new book describing the Link-Belt Rotary Railroad Car Dumper. This book illustrates the dumper in various positions, and a double page spread points out the main features of its mechanism. With the development of the Rotary Railroad Car Dumper described in this book, No. 1004, the economies of the lifting type of dumper have been brought within the reach of those whose unloading requirements are small.

Design Standards for Oxwelded Steel and Wrought Iron Piping.—This is intended to enable the engineer and architect to design gas welded steel or wrought iron piping systems, for any purpose, according to the best practice yet developed, and covers all of the necessary structural details. This booklet has been published to meet a definite demand created by the extensive application of the welding process of modern piping services, and should prove of interest to designing engineers and architects. It is available through district offices of the Linde Air Products Company. 30 East 42nd St., New York.

Modern Power Plant Equipment-A 48-page cooperative book has been issued by The International Nickel Company, Inc., for power users. It contains several features on power plant equipment of the past and present and traces results which have been obtained in many industries with the use of rustless metals like nickel and Monel Metal. It is illustrated throughout. There is a foreword by Fred R. Low, Past-President of the American Society of Mechanical Engineers, and an article on the development of power equipment through the ages by L. Guerin. book contains reprints of the advertisements of thirty leading manufacturers of power plant equipment which have been published in various trade and technical papers. It is available without charge.



Examine a section of deLavaud cast iron pipe and note the fine and even grain of the metal. Laboratory tests have shown that deLavaud pipe combines flexibility with at least 25% greater strength.

The reason for the fine granular structure of deLavaud pipe metal is due to its unique process of manufacture. deLavaud pipe is cast in a rapidly revolving cylindrical mold. This mold is cooled by a specially constructed water jacket. When the molten iron comes in contact with the chilled surface of the mold, the abrupt change of temperature brings about the uniformly fine division of the iron particles.

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#### Asphalt Producers Form Institute

The Asphalt Institute, a new organization whose membership is made up of the producers of asphalt and asphaltic oil responsible for more than ninety per cent of the production east of Rocky Mountains, succeeded The Asphalt Association on January 1. The new organization will conduct extensive educational and research work pertaining to all the uses of asphalt and asphaltic oils.

The Asphalt Association was composed of producers and manufacturers but it confined its activities entirely to paving asphalts. The various branches of the asphalt paving industry will now be realigned more effectively in appropriate organizations and already the hotmix paving contractors have formed an association known as The Asphalt Paving Association, of which Frank J. Silsbee, Engineering Building, Chicago, Illinois, is secretary, and Frank O. Hotson, a leading contractor of Gary, Indi-

ana, is president.

The officers of The Asphalt Institute who will serve during the brief period until the first annual election in March are as follows: Joseph S. Helm, Standard Oil Company of New Jersey, New York City, chairman, Executive Committee; Leroy M. Law, Shell Petroleum Corporation, St. Louis, president; William H. Kershaw, The Texas Company, New York City, vice-president; C. W. Bayliss, Barber Asphalt Company, Philadelphia, vice-president; B. L. Boye, Standard Oil Company of New York, New York City, secretary; Fisher Jones, Mexican Petroleum Corporation, New York City, treasurer, and J. E. Pennybacker, New York City, manag-ing director. The executive, engineering, editorial and technical staff of The Asphalt Association will be taken over by the Institute intact, with Prevost Hubbard, chemical engineer, in charge of research and technology and Clifford S. Lee in charge of public relations. The Asphalt Institute, as did The Asphalt Association, will have its offices for the present at least, at 441 Lexington avenue, New York.

While The Asphalt Institute is authorized to deal with all the uses of asphalt, its major activities during 1930 will be directed toward the improvement and extension of asphalt for city streets and rural highways. In the latter field it is already devoting particular attention to the national program of low-cost farm-to-market roads now being stimulated by such powerful organizations as the American Farm Bureau Federation and many other leading agricultural, civic and motoring organizations. A very practical and useful activity by the Institute in connection with low cost roads is a cooperative investigation as to types, specifications, methods and materials it is conducting in cooperation with the U. S. Bureau of Public Roads through committees representing both the Bureau and the Institute, headed by H. S. Fairbank, Chief of the Research

Committee of the U.S. Bureau of Public Roads, and J. E. Pennybacker, managing director of the Institute. Resurfacing of all types of highways is engaging the concentrated attention of highway engineers and officials in all parts of the United States and since asphalt is ideally adapted for resurfacing all types of pavement at low cost the new organization will give special attention to this field.

The Asphalt Institute will also devote considerable attention to the elimination of objectionable and unsound trade practices and to building up a practical and commendable code of trade ethics. It will also cooperate with the U.S. Department of Commerce and other government agencies in the simplified practice field, looking to the elimination of unnecessary grades and the development of sound bases for conducting the business of the Institute. Actual promotion of asphalt in the sense of personal participation in local paving jobs will not be a feature of institute work but will be left to competitive effort by the various producers and contractors interested. The institute's efforts will be directed wholly along sound technical, engineering, educational, scientific and informational lines.

The annual Asphalt Paving Conference, which has become a recognized useful institution as a forum for discussing the practical problems of asphalt paving design, construction, maintenance, and economics, will be con-tinued under the auspices of The Asphalt Institute, but with the cooperation of other organizations, particularly the American Association of Asphalt Technologists. This latter organization, formed seven years ago, is made up of technologists serving the states, cities and counties as well as those engaged in the industry, and is headed this year by Prevost Hubbard of The Asphalt Institute, as president and Charles L. Mullen, of the Milton Hersey Company, Montreal, Que., Canada, as secretary.

The extensive asphalt literature developed by The Asphalt Association has been taken over by The Asphalt Institute, together with all other assets, and distribution of these publications, supplemented by attractive new and additional brochures, manuals and circulars to carry on this phase of the educational work, will be continued on a larger scale than ever before.

#### New York State Sewage Works Association

The January meeting of the New York State Sewage Works Association will be held at the Hotel McAlpin, New York City, on January 18. The tentative program is as follows: 9:10 a. m., registration; 10-12, inspection Canal Street screening plant, New York City; 12:30, luncheon, Hotel McAlpin; 1:30-5:30, technical session:

"The Sewage Disposal Problem in the Metropolitan District": (a) "New York City"—Arthur S. Tuttle, Consulting Engineer, Board of Estimate

and Apportionment; (b) "Westchester County"-Representative of Westchester County Sanitary Sewer Commission; (c) "Passaic Valley"—J. Ralph Van Duyne, Chief Engineer, Passaic Valley "Dissolved Sewerage Commission. Oxygen Conditions in the Harbor Waters of the Metropolitan District"-W. T. Carpenter, Chemist, Board of Estimate and Apportionment, New York City. "Industrial Wastes Problem in the Passaic Valley"—William Gavin Taylor of Taylor & Knight, Consulting Engineers, Newark, N. J.

Topics for Round Table Discussion:

Dangerous wastes as affecting sewers and sewage disposal; curb or gutter inlets-use of catch basins; experiences with tide gates and regulators on intercepting sewers; desirability of sewers under each sidewalk; the handling of screenings; pollution tests for beaches,

pools and baths.

#### Missouri Water and Sewage School

Through the cooperative efforts of the Engineering School at the University of Missouri and the Missouri State Board of Health, arrangements have been made to hold a short course of instruction for water purification and sewage treatment plant operators and superintendents.

The short course will last three or four days, during the latter part of February, 1930, and will be held in the Engineering School Laboratories and lecture rooms at Columbia, Missouri. Lectures will be given on the principles, purpose and interpretation of water and sewage chemistry, bacteriology, and biology. Mimeographed copies of these lectures will be given to all in attendance, consequently, no notes need be taken. Following the lectures, the class will be taken to the laboratories and the simple tests and analyses discussed in the lecture will be made by each individual. There will be no enrollment or attendance fees of any sort. The only expense will be room and board while in attendance.

It is requested that each person who is eligible for the course of study notify the State Board of Health not later than January 15.

#### Minnesota Well Drillers' Association

The American Association of Water Well Drillers will hold its convention in conjunction with the Minnesota Well Drillers' Association at St. Paul, Minn., February 4, 5, and 6.

Delegates from eight states will be present. An attendance of about 400 is expected. Meetings will be held in the Engineering Building, University Farm, Midway, St. Paul, Minn.

The National Council, including representatives of each state drillers' association, engineers, geologists, manufacturers, the National Research Council, and the U. S. Geological Survey will consider such questions as drilling standards and ethics, specifications for wells, equipment standards, etc.

# W-K-M

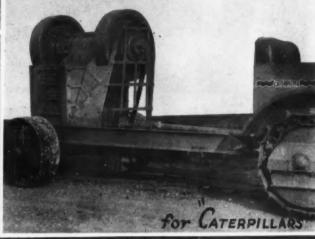
# **EQUIPMENT**



New and Exclusive!

HY invest in a new machine for clamshell, dragline, backfill, or handling work—letting your tractor lay idle—when you can obtain the use of all these in a W-K-M Side Boom UNIT? While obtaining the use of these you still retain the use of the drawbar for pulling! A The W-K-M Side Boom UNIT offers a number of advantages. The collapsible boom permits extension to various lengths. For backfilling ditches, laying pipe, and similar work, the side mounting of the W-K-M Unit affords a number of outstanding advantages. A Installation is very simple, easy and quick. The unit can be dismounted or mounted right on the job. Moreover, the cost of the

right on the job. Moreover, the cost of the complete unit is probably the most reasonable of any on the market today. Materials used are the finest obtainable. A Distributed exclusively through "CATER-PILLAR" dealers.



OR building and maintaining roads, the W-K-M DAY JAW CRUSHER has no equal! It is rugged, substantial, and thoroughly reliable. Instead of gathering rocks, stone, etc., along the roadway, transporting them to a centralized crushing plant, and incurring the extra expense of transporting them back to the scene of work, you can crush them as you find them! A The W-K-M Crusher is both drawn and operated by a "Caterpillar" tractor. Rocks can be crushed in various sizes and adjustments in size can be made even while the machine is in operation. When not in use, the crusher is constructed to permit disconnection in two minutes, thus making the tractor available for other purposes. A Distributed exclusively through "CATERPILLAR" dealers.

# The W-K-M CO.Inc.

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## Engineering and Construction Equipment

New Machinery, Apparatus, Materials and Methods and Recent Installations.

#### Allsteel Side Winch

The Allsteel Products Mfg. Co., of Wichita, Kans., manufactures a side winch and boom for use in laying water and sewerage mains. The winch is equipped with 4-speed transmission which enables it to handle various loads at any speed desired. It is particularly adapted to laying heavy cast-

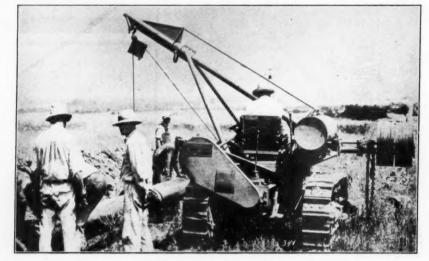
7 x 8½ Atlas Imperial Diesel, or a larger AC or DC electric motor. These motors have been selected for their "follow through" and reserve power characteristics and any of them may be used without major changes to the turntable. Power is transmitted from these power plants through a power take-off and silent chain drive directly to the center drive pinion which

with newly designed driving pinions, which, with the larger power plants, give a 12% greater tractive effort. The major improvement in the propelling mechansm proper is on the steering and traveling clutches which are mounted on splined sections of a horizontal propelling shaft of increased diameter. The car-body, a one piece casting, is made heavier, with rigid radial bracing and is capable of supporting the entire dead weight of the unit, plus the tipping load of a 15-ton crane at any axle support. Two crawler speeds of ¾ and 1½ miles per hour are standard.

The standard crawler mounting has 2 self-laying crawler tread belts consisting of a total of 56 treads. By replacing the standard single end rollers with equalizer rocker arms, "64" and "68" tread crawlers with overall lengths of 14 and 15 ft. respectively result. These mountings are available for dragline, backdigger, clamshell and crane use. Their greater length reduces ground pressures of 15% to 25%, while the "rocker" action of the equalizer rocker arm prevents nosing-in and makes the unit self-adjusting to the unevenness of the ground in traveling.

A further classification of improvements and refinements on the Lorain-75-B may be divided as follows:

Shovel Unit—The center drive shovel boom is said to have greater operating ranges than any other shovel equipped with the same length of boom and dipper stick. The crowd motion is powered by a positive, roller chain with improved "take-up" device. An automatic crowd brake enables holding the stick extended without any attention whatsoever from the operator. An automatic power trip to the dipper of a new design is also included. Strength and power to handle a 1½-yd. dipper



Allsteel Side Winch for Caterpillar Tractors

iron pipes and sewer pipes. The tractor is available for drawbar use in skidding pipe, hauling it over soft or sandy soil, and other purposes. When the winch and boom are mounted on a Hill-side Special "Caterpillar" 30 tractor and equipped with 2700 pounds of counterweights (which are standard equipment) it will lift 6000 pounds from the end of the boom, with the center line of the load 5 ft. 2 in. from the track. By use of a stiff-leg (which also is standard equipment), the winch will lift 40,000 pounds on a single line.

in turn powers the three shafts, hoist, swing and travel or crowd. The application of power to all these shafts and operations is by means of newly designed, simplified internal expanding clutches of generous size. Roller bearing type boosters on the hoist and swing shafts are provided for easier operation.

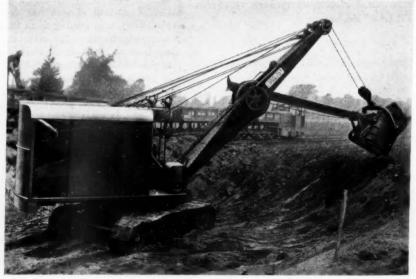
The primary change in the crawler mounting is that it is 12% longer than previously and 2300 pounds heavier. It is propelled by Thew center drive,

#### The Lorain-75-B Heavy-Duty Gas-Diesel-Electric

The Lorain-75-B, a new, improved heavy duty 1½-yd. machine, has been announced by The Thew Shovel Co., Lorain, Ohio. Like the ¾-yd. Lorain 45, the 1-yd. Lorain 55 and the old 1½-yd. Lorain-75-B, the new Lorain-75-B is of Thew center drive design in turntable, crawler and shovel boom.

The Lorain-75-B improvements may be divided into 2 general classes: those on the turntable and those on the crawler mounting.

The general turntable changes consist of a general increase in strength and ruggedness throughout. Larger and more powerful power plants are provided by a Waukesha "W. L." gasoline engine rated at 97 horsepower, a



Lorain 75-B Gas Diesel Electric Heavy Duty

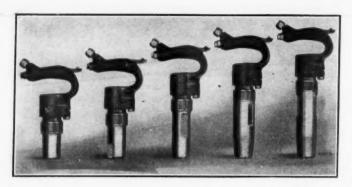


# THE 1930 NIHE

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THE FOOTE COMPANY, INC. OF NUNDA, N. Y. World's Largest Exclusive Builders of Road Pavers



Ingersoll-Rand
Pneumatic
Chipping
Hammers

on heavy duty work and a 1½-yd. dipper on many other classes of work.

Clamshell—"64" and "68" tread crawler mountings, 15-ton lifting power capacity, 40 to 60-ft. booms (or longer) and a patented swivel sheave tagline that automatically maintains the tagline sheave in line with the bucket.

Dragline—"64" and "68" tread crawler mountings, and a new style 2-sheave Timken-roller bearing fairlead, off a shock-absorber, full floating type in which the cables always automatically adjust the sheaves to side pulls, etc., maintaining straight cable leads.

Backdigger—a newly designed simplified boom with a direct pull and application of power to the dipper. The tilting dipper, independently controlled, is of course retained.

#### Ingersoll-Rand Pneumatic Chipping Hammers

Ingersoll-Rand Company, 11 Broadway, New York, has developed a new line of high speed pneumatic chipping hammers. An interesting feature of these hammers is the use of a plate valve of the flapper type that results in several important advantages. The flapper valve, being a thin beveled plate, permits the hammers to be made shorter in overall length and also lighter in weight. The valve flaps down on its seat in a valve box to close the air ports and rises to open them. This action gives quick and full opening and closing of the air ports, resulting in exceptional power and speed. There is no sliding movement to the valve, and, consequently, it has a smooth and positive action, easy holding and sensitive throttling. Furthermore, the valve does not wear, but its fit on the valve box improves with use. It is claimed

that this valve practically does away with valve maintenance problems.

Another feature is the throttle valve, of a combination piston and poppet type that gives very fine graduation of port opening and that remains tight for a long period of service.

Open type handles are standard on these chippers. The handles screw on the barrels and are securely locked in place by a new type of pinch bolt arrangement. The exhaust is through the side of the barrel and can be deflected in any desired direction by means of an adjustable exhaust deflector.

The hammers are furnished in five sizes as follows: Size 000—34" stroke; Size 100—1" stroke; Size 200—2" stroke; Size 300—3" stroke; and Size 400—4" stroke. These five sizes are designed to meet all the conditions encountered in the various classes of chipping and calking work. It is claimed these new hammers will turn out more work with less fatigue to the operator and that their high power gives both faster and heavier cutting. Their high speed makes possible an extremely smooth cut.

#### New Barber-Greene Offset Vertical Boom Ditcher

The Barber-Greene Company of Aurora, Illinois, has brought out a light ditcher with an offset vertical boom. The offset boom is not offset in any fixed position, but may be set at any desired position between the crawlers on which the machine is mounted and locked there.

This new machine is patterned generally after the standard vertical boom ditcher, but there are several noteworthy features incorporated in its design. Among its advantages are its ability to dig directly up to any object such as a sidewalk or curb, ending the trench flush, leaving no ramp to be removed by shovel labor. It can start a ditch straight down, in fact it has been used for digging manholes. It can cut a square corner.

In addition to being vertical in construction, the boom on the utility ditcher may be esaily offset  $13\frac{1}{2}$  inches to either side of center by means of a ratchet and screw in a few minutes. With the boom offset, the ditcher can dig to within 15 inches of any obstruction such as a telegraph pole, wall, or curb. The vertical offset feature is an innovation in the ditching field.

Another feature of the new ditcher is the automatic overload safety sprocket. This affords protection for the machine against overloads, and for pipes and other underground installations against breakage which would prove expensive to the contractor. When an obstruction is encountered, the sprocket slips, stopping the bucket line; it catches every half revolution, then slips again. This action will continue without harm to the machine until the obstruction has been removed, or the buckets have milled through it.

The boom is raised and lowered by power, and an automatic throw-out makes it impossible to raise the boom too high.

The whole machine is mounted on crawlers of standard Barber-Greene design by means of a fixed and an oscillating axle. The oscillating axle provides three-point suspension for the machine, which enables it to ride over rough ground and stay on an even keel.

The machine is powered with a Buda 38 h. p. gasoline engine and is driven through two especially designed transmissions. It has four road speeds—three forward and one reverse, with a high forward speed of 2 1-3 miles per hour—and a great number of digging speeds ranging from 12 inches to 148 inches per minute. There are cutting speeds to suit any soil condition.

The utility ditcher cuts a trench from 9 inches to 18 inches wide and from 4 feet to 5 feet 6 inches deep.







New Barber-Greene Offset Vertical Boom Ditcher

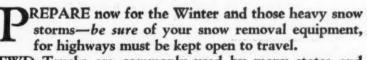
TRACTION



and POWER on each wheel

trucks keep highways open at Low Cost!

FWD Trucks are made in 2 to 10 ton sizes—four wheel trucks, six wheel trucks, tractor trucks. Let us send you specific bulletins.



FWD Trucks are commonly used by many states and counties because they have better traction and power and because they more readily adapt themselves to snow removal work.

All FWD Trucks drive and brake on all four wheels.

They can be used with any type of plow and are capable of traveling at a good rate of speed. Besides snow removal work, FWD Trucks can be used for general hauling, road building and maintenance—they are economical all year—all purpose trucks. Send for special removal bulletin. Write today,



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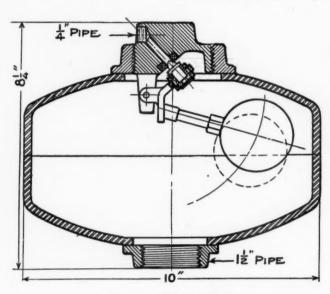
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#### Apco Automatic Air Relief Valves

The Automatic Primer Co., 111 West Washington St., Chicago, Ill., manufacture a line of air relief valves, which are suited for a variety of work. Nos. 50, 60 and 70, operate under pressures up to 125 pounds; No. 100, at pressures up to 200 pounds; and Nos. 110, 120 and 130 at pressures up to 500 pounds.

A crane is provided to be used in charging and emptying the generator. With this crane it is an easy matter to lift the gas-bell out of the generator. The water and residue can then be drained off through the outlet at the bottom. The crane jib is made in three sections, which can be telescoped when not in use to decrease the height. The truck has two 24-in. steel wheels with 3-in. tires, and a castor wheel which is 12 in. in diameter by 2 in. All



Apco Air Relief Valve

These valves are designed to release automatically accumulations of air from pipe lines, pumps, and various other places. They are simple in design and operate without attention. They are low in price. As ordinarily used, they will pass air both in and out, but will close at once on liquids. By inserting a vacuum ball in the head of any of them, air will be passed out but not in.

#### Two New Trucks for Carbic Generators

The Oxweld Acetylene Company, New York, has recently introduced two new types of trucks to accommodate Type CLP-3 and Type CLP-2 Carbic low-pressure acetylene generators, respectively. The truck designed to carry a CLP-3 Carbic Generator also carries two cylinders of oxygen. Two large wheels carry the back part of the truck; a third wheel, in the front, is of the castor type and allows the truck to be turned in a radius about equal to its own length. The generator is secured to the steel deck of the truck by means of angle iron braces and two long bolts which are inserted in the handles of the generator and tightened by means of turnbuckles.

The truck is provided with a steel tool box with loop fastenings. This box can be used for wrenches, small tools, or for a welding or cutting outfit. The oxygen cylinders are chained to a steel rack which is fastened to the deck of the truck beside the generator.

wheels are provided with grease cups for lubrication.

The smaller truck will accommodate one cylinder of oxygen in addition to the Type CLP-2 Carbic Generator. It is designed for extreme portability and can be wheeled anywhere with ease. There are two 24-in. steel wheels and one 5-in. castor wheel.

#### Oliver United Filters in Activated Sludge Treatment

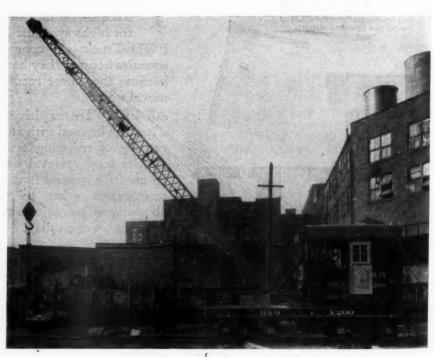
Oliver United Filters, Inc., of San Francisco, Chicago, and New York, has developed activated sludge filtration to a highly efficient and practical degree. Automatic, continuous vacuum filters are used, providing a clean, neat, compact installation and producing a relatively dry cake in demand for fertilizer. Already several cities, treating sewage by the activated sludge method, use Oliver United filters. Among these cities are Milwaukee, Gastonia, N. C.; Charlotte, N. C.; Pasadena, Chicago (Calumet), Houston, Texas.

#### Diesel-Operated Industrial Brownhoist Crane

A diesel-operated, 25-ton capacity locomotive crane has recently been announced by the Industrial Brownhoist Corporation of Cleveland. These cranes, the first of this capacity to be powered by diesel engine, have been fully demonstrated and in every case their performance has been satisfactory.

The diesel engine on this new Industrial Brownhoist is of the six-cylinder, two-cycle, solid injection type and burns any ordinary grade of fuel oil. The entire operating mechanism is mounted on a one-piece, cast steel rotating bed and the side frames are also made of steel castings. The power take off from the engine is fully enclosed, runs in oil and is equipped with Timken roller bearings.

Ten of these cranes were recently purchased by one of the large eastern railroads and are now being placed in operation. Because of their low operating costs and ability to start and stop quickly, it is expected that these Industrial Brownhoists will effect marked economies for their owners.



Brownhoist Crane With Diesel Power

tractors.



# **Building** an Airplane"Road" in Canada's Cold November

Photograph of the Colas built taxiway of the Dominion Government Airport at St. Hubert, Que., Canada. Dibblee Construction Company, Con-

When the contractors on this job were faced with the problem of building approximately 90,000 square yards of taxiway by the penetration method, in cold November weather long after other road contracts had been closed down due to the impracticability of hot asphalt construction at this season,—they turned to Colas,—because Colas only could solve their problem. Colas is a pure bituminous penetration and surface dressing material that is efficient at ANY temperature above freezing. Colas is applied cold,

Cofus is ideal for quick and economical construction, or maintenance of all macadam and gravel roads. Colas has a long record of success in England and on the Continent.

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duced in America, Colas is surpassing its European successes.

direct from a pressure tank and produces a hard, smooth, non-skid lasting surface that can be used immediately after completion. Only recently intro-

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builds durable low-cost roads

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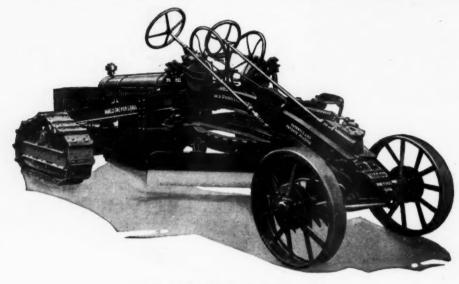
#### Detroit Heavy Duty Highway Mower

The Detroit Harvester Co., Detroit, Mich., manufactures a heavy duty highway mower which is especially adapted for mowing shoulders along roadsides. It is stated that, no matter how heavy the growth of grass or weeds, this mower, with one man only for opera-

high carbon, special rolled steel, will not take a permanent set or crystallize, and break from the severe strains to which they are subjected in heavy service.

Warco head auto type steering gear and enclosed lifting mechanism which operate in a bath of grease, are also features. Independent scarifier, double end side crank for motor, and snow When any light or electrical device drawing electricity from the plant is turned on, the plant starts and supplies current. It also stops automatically when the last electrical appliance is turned off. Thus no large sets of storage batteries are needed, only a small battery being required for starting. The device that starts and stops the engine is a special automatic switch found only on Kohler Electric Plants.

Kohler plants are of particular value in a large variety of work, such as supplying electricity in places such as farms, gasoline filling stations, industrial and construction villages, camps and resorts, and for construction work, road or building equipment, airports, and emergency landing fields and as aerial beacons.



Improved Model E Warco Grader

tion, will cut from 30 to 40 miles of roadside per day. It will do the work of at least three horse-drawn mowers, and where the going is heavy, will exceed this ratio.

The mower is adapted to the McCormick-Deering 10-20 Industrial tractor, which assures a high degree of mechanical satisfaction and ready servicing and repairs. All gears and shafts are of special heat treated alloy steel, and the shafts are mounted on ball bearings. Control levers are at the right hand of the operator. The mower bar is optional in 5 and 6-foot lengths, and two sickle knives are furnished with each mower.

#### Warco Improves Model "E" Power Road Grader

Improvements have been announced for the Warco Model "E" power grader by the W. A. Riddell Company, Bucyrus, Ohio.

A new circle, of special design, has been placed on the model "E." This circle consists of a one-piece steel casting so constructed that the blade hanger is securely attached to it and the whole firmly mounted in the circle drawbar. It is claimed that this new circle will reduce blade chatter still more, and will give greater stability and easier control to the blade assembly.

The model "E" has also been strengthened in certain parts subjected to unusual stress and wear. Many of the outstanding features of the "E" grader have been retained, such as the frame construction, which is of heavy I-beam type. The frame is bent in a true radius, eliminating all sharp bends. The frame members being of special

plow or bulldozer attachments, can be secured at slight additional cost. The machine can be furnished upon either rubber tired wheels or with Warco rear type crawlers. These mountings are interchangeable on the same axles and can be made in the field by local forces in a very short time. The wheel mountings are suited for maintenance and speedy movement. The crawlers are best on heavy construction work, and where the going is exceedingly difficult. The crawlers have a

bearing area somewhat less per pound per square inch than that of the average man, so that they will take a tractor or grader most any place where work can be done.

#### Kohler Electric Plants

The Kohler Co., of Kohler, Wisconsin, manufactures the Kohler electric plant, a portable four-cylinder engine directly connected, by means of an extended crankshaft, with an electric generator.

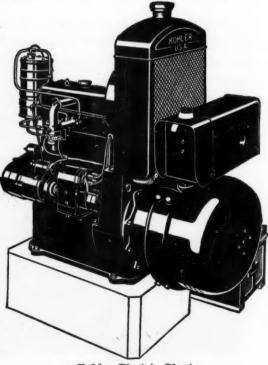
Built in five sizes, of 800 watt, and 1½, 2, 5, and 10 K. W. capacities, and available in a total of more than fifty different models, the Kohler units operate on gasoline (although they also may be fitted with a gas valve to operate on artificial or natural gas) and supply 32, 110 or 220 volt direct current or 110 or 220 volt alternating current for use wherever electricity is desired.

Electric current is furnished automatically by the plant.

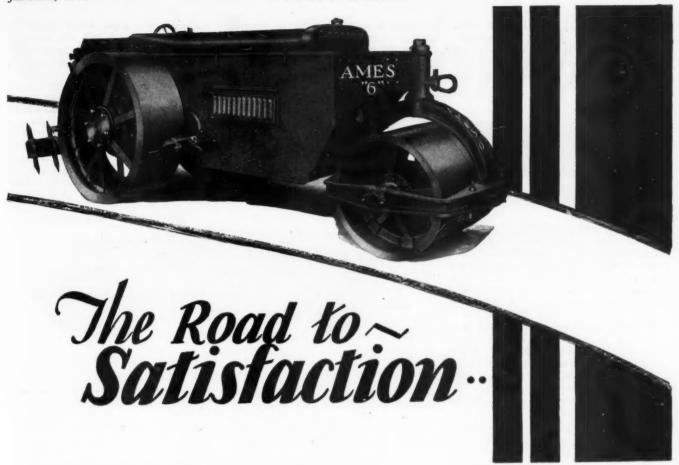
#### New Continental Motor Bus Engine

Muskegon, Mich., announces the development of the model 20Z bus engine of 150 h. p. The model 20Z is a six-cylinder vertical valve-in-head type, with a 5½-inch bore and 6-inch stroke. Piston displacement is 779.3 cu. in. total for six cylinders. Cylinders contain removal sleeves of nickel iron which from a service standpoint is an economical feature. These sleeves can be replaced easily and quickly. The cylinder head of nickel iron is a separate unit, removable, carrying rockershaft and valve mechanism, with ample air passages around valves and spark plugs.

Five rings are used on the nickel iron pistons. The pins are held in place by retaining rings fitted in the grooves of the pistons at each end of pin. Pin bearings are phosphor bronze bushings in connecting rode



Kohler Electric Plant



THE AMES This roller was first exhibited at the Annual Road Show in 1929, at which time it created more than usual interest among road building contractors and public officials everywhere. Our chief aim was to have the best roller possible to produce, with every customer satisSales have exceeded SIX CYLINDER fied. This we have done. Sales have exceeded production but with increased and improved manufacturing facilities we are now in position to meet in 1930 the ever increasing demand for these high grade rollers, now offered in 5, 7, 10 and 12 ton sizes, each with 6 cylinder motor only. There will be many new and interesting features on the 1930 models. See them at the Road Show. Make the AMES booth your headquarters and bring along your friends. There'll be a welcome awaiting you. We shall have

T 9 8 0 convention & ROAD SHOW A.R.B.A. atlantic city hu. JAN 13-18

Officials there to meet you Salesmen there to greet you Rollers there to please your eye Engineers to tell you why. THE FIRST AND ONLY SIX CYLINDER ROLLER

#### **AMES IRON WORKS**

Division of Pierce, Butler & Pierce Mfg. Corp.

OSWEGO, N. Y.

Crankcase is gray iron integral, with cylinder water jackets. Aluminum oil pan is a separate unit. To insure added smoothness a seven-bearing crankshaft, with 31/4-inch main bearing diameters is used.

but three seconds, while but 20 seconds are needed for lowering. The one-man control feature is an important one irrespective of its speed for it releases other men for duty elsewhere.

In the new aerial models the entire

These new scoops, which are of 2-yard capacity, level full, are operated in the same manner as the smaller 1-yard scoops. A lever and a latch are the only controlling mediums necessary. With the latch in place a slight pull on the lever hand line actuates the clutch and by the tractional force of the wheels causes the bowl to be lowered into cutting or loading position, where it is held, at the desired depth, by a slight tension on the lever rope, until the bowl is filled. By releasing the tension on the lever, the bowl automatically swings



LaFrance Aerial

Cooling system consists of a centrifugal water pump located on left-hand side of motor and driven by accessory shaft through flexible coupling at 1.5 times crankshaft speed. The water pump is easily removable. The oiling system consists of helical gear type oil pump driven from the camshaft by spiral gears. Pressure feed is used to crankshaft bearings, connecting rod bearings, camshaft bearings, valve mechanism, accessory drives and timing chain, and special type oil filtrator is provided. Oil pressure adjustment is located on the right-hand side of crankcase.

Besides the Model 20Z there will be two others of this series, namely: The 16Z—4¾-inch bore and 6-inch stroke, and the 17Z—5-inch bore and 6-inch stroke. These two models will embody the same features as are incorporated in the 150 horsepower job and will be announced shortly.

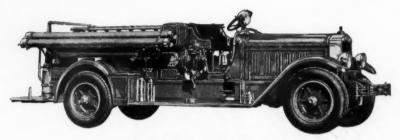
#### New Series American-LaFrance Fire Apparatus

Announcement of new "Master Series" motor fire apparatus is made by the American-LaFrance and Foamite Corporation of Elmira, N. V. The new series is composed of a complete new line of motor fire apparatus, featuring two pumping engines known as the "Metropolitan" and "75," a new city service truck and a complete list of aerial trucks. Production on all the new models is now under way.

Major improvements have been made on all models of the new line, while at the same time proven features of stamina and reliability have been retained.

Outstanding among the general improvements in the line leaders are: Left-hand drive instead of right-hand, allowing greater visibility and ease of handling in traffic, specially developed mechanical four-wheel brakes, fully enclosed of the two-shoe type; and hollow spoke cast steel wheels.

Besides these, is the feature of oneman control which means that one man can raise and bed the ladder. Both operations can be accomplished in quick time. Raising the main ladder requires



New LaFrance Fire Truck

assembly for raising and lowering the ladders is located at one side of the turntable. Other aerial features include stronger ladders, improved rear wheel steering and better seats for tillermen.

#### New Warco Wheeled Scoops of Large Size

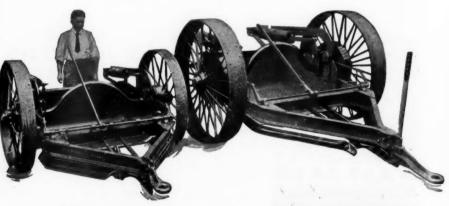
W. A. Riddell Company, Bucyrus Ohio, has designed, developed and thoroughly tested a new wheeled scoop of large size. This new scoop is carried by two land wheels 66 inches in diameter and with 10 inch rims. A heavy bowl or pan is supported upon a full length, one piece, axle, formed from nickel steel. This axle is arched high in the center to afford maximum loading space in the bowl. The wheels are Timken bearing mounted and are equipped with clutch housings which contain clutches of the progressive internal expanding band type. The clutches and Timken bearings are enclosed, protecting them from dirt and other foreign matter.

into the raised or carrying position so that the load rides high and free. In this position an end gate automatically closes the front of the bowl. In order to dump, the latch is raised by means of a hand line and the clutch control lever is again pulled. The operator can dump the material in a heap or spread it as thinly as he wishes.

These scoops are operated in trains of two or more, depending entirely upon the tractor's power. The ordinary 10-ton type tractor will operate 3 of the model "T" or 2-yard scoops without difficulty.

A train of the scoops can be turned in a highway 20 feet wide. The operations of the scoop are continuous, as it is not necessary to stop the tractor either to load or dump. When operating in trains, the functions of the various scoops are controlled from a loading platform on the leading scoop through hand lines, by one man.

These scoops have given good results in excavating, transporting, and spreading earth on hauls up to and even somewhat exceeding two thousand feet.



Riddel Large Wheeled Scoops for economical dirt handling

# oth, austless Roads

# Economical to build and maint

ROADS that will not withstand year 'round heavy traffic can be improved without discarding the present paving. Just bring them up to date.

Such roads can be made into modern, farm-to-market highways with various treatments combining mineral aggregate with Standard Asphalt Road Oil or Stanolind Cut Back Asphalt. These road treatments do not strain the construction budget.

Thousands of miles of such improved highways in the Middle West have given many years of service with little expense for upkeep.

It will pay you to investigate before you build. Fill in the printed form below and mail it for full information.

Wisconsin State Highway No. 13 in course of construction. Treating subgrade of gravel with Standard Asphalt Road Oil. 300 to 400 yards of gravel to the mile. When completed, it is a good road in all kinds of weather.



Missouri Highway. Mixed-in-place Method, using Standard Asphalt Road Oil and three inches of gravel. Thousands of miles of road built by this method are giving and service in many. giving good service in many counties and cities in the Middle West.



Linn County, Iowa. Re-tread construction. Showtreda construction. Show-ing first application of Stanolind Cut Back As-phalt mixed in place with mineral aggregate. Sep-tember, 1929.





One of these four types of road surfacing will meet your present traffic conditions

Treatment of Sub-grades with Standard Asphalt Road Oil builds up a smooth, dustless, all-weather highway at very low cost. This method of building conserves the material gravel supply, and in this way it greatly reduces the cost of the road.

Mixed-on-the-Road Method of combining Standard Asphalt Road Oil and Gravel gives a threeinch bituminous bound, smooth surface. This type of road can ordinarily be constructed and maintained as cheaply as an ordinary gravel road.

Surface Treatments with Stanolind Cut Back Asphalt are used successfully wherever the road to be treated is constructed of a well compacted mineral aggregate.

Stanolind Cut Back Asphalt retread (or mixed-inplace method) is an economical means of salvaging old bases of gravel or crushed rock. This type of pavement, mixed on the road, is constructed by mechanical means, which results in very low construction costs.

STANDARD OIL COMPANY [Indiana]

STANDARD O	IL COMPANY (Indiana) cations and discousand in the cations are cations are cations and discousand in the cations are cations are cations and discousand in the cations are cations are cations are cations and discousand in the cations are cat
Send me specifi	IL COMPANY (Indiana) ran Avenue, Chicago, Illinois cations and other information regarding if for building good roads.
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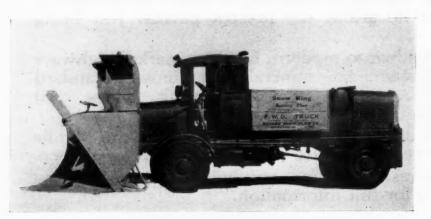
halt and road oil for low cost improved roads

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#### Convenient and Intense Heat for Laboratory Work

Laboratories of various sorts do a great deal of their experimental and research work with the aid of small flame apparatus. A most convenient and complete laboratory installation consists of a small tank of dissolved acetylene; a hot plate; a Bunsen burner; an acetylene-and-air torch with air control; a reducing valve; a three way branch valve, and the necessary red gum tub-

the needle point flame produces approximately 3,300 degrees Fahrenheit, making it suitable for any work requiring high temperature. A wide latitude of temperature control is possible by adjustment of the gas pressure, providing a range of heat in many metals, from near melting, to the molten stage. The hot plate and Bunsen burner recommend themselves by their convenience, cleanliness and intensity of the flame. They save time and keep instruments and utensils free from soot and smoke.



FWD Snow Removal Unit

ing. With this outfit all manner of laboratory tests can be undertaken. Dissolved acetylene has many distinct advantages over liquid or other gas fuels. It not only produces a higher flame temperature than coal gas or natural gas, but forms a flame that can be perfectly controlled. This flame is non-oxidizing and non-carbonizing as well.

A special type of torch has been developed for test work and uses compressed air in addition to dissolved acetylene. The flame may be changed from the brush type to an intense needle point by adjusting the air supply. This accomplished by a simple twist of the adjusting screw. The brush, or Bunsen flame, has a temperature of approximately 2,800 degrees Fahrenheit and

#### The Koehring Dumptor For Earth Handling

The Koehring Co., Milwaukee, Wis., has brought out the Dumptor, a distinctly new load carrying unit, which is said to be the only one of its kind on the market.

With full multiplane traction for mobility and easy handling over most any kind of ground, with the ruggedness and liberal drawbar power of a tractor, and with the bull dozing advantages of the dump body in discharge position, the Koehring Dumptor is a heavy duty unit embodying the profitearning and dirt-handling features of truck, tractor and bull dozer.

The unique design of the Dumptor

includes twin four-cylinder engines, front end dump, low loading height and reinforced body of exceptional capacity—struck level of 5 cubic yards, heaped load of  $6\frac{1}{2}$  cubic yards and more.

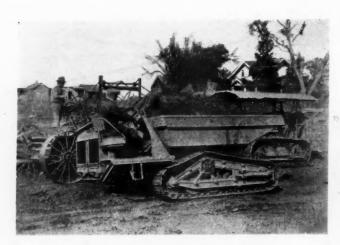
#### New FWD Snow Removal Unit Developed

A new snow removal unit that may revolutionize heavy snow handling on highways has been developed by engineers of the Four Wheel Drive Auto Company of Clintonville, Wisconsin, manufacturers of FWD trucks, and of a rotary snow removal machine.

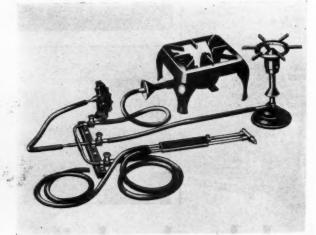
A feature of the new unit is that two engines are mounted on the truck in such a manner that the truck may be driven by either motor. The truck looks like any other FWD except that the extra motor is mounted on the rear of the chassis. In deep drifts of snow the rear motor is used to propel the truck, leaving the full torque of the forward motor available for operating the rotors of the snow plow. Where the snow is not exceptionally deep the rear motor is cut out and the truck and snow plow rotors are driven by the forward motor alone.

One of the reasons why two motors are used instead of a single large engine of equal horsepower is to provide an economical unit for all year around road maintenance, for it has been found that it is not always practical to use only one large motor capable of handling both the rotary snow plow and the truck. A truck with a single motor of this type would be considered a special unit which could not be used economically in any other kind of work. The investment in such a special truck would be impractical for most highway departments. The rear motor of the new double-motored snow remover is so arranged that it can be removed easily. leaving the truck with its regular motor ready for other truck work.

Not only is it more economical to use flexible unit. By using two motors the speed at which the rotors may be oper-



The Koehring Dumptor—a distinctly new type of load carrier



A Convenient Laboratory Outfit

# YOU Builders of Our Country

Are going to have a better, a more prosperous and a more profitable New Year . . . YOU deserve it . . . YOU who build water works and sewage plants, lay water mains and install sewer systems . . . YOU who make building foundations, build dams and subways . . . YOU who are responsible for our wondrous growth and of whom we are all justly proud ... YOU who have uncomplainingly forced your work along with far from perfect equipment . . YOU deserve something better . . . Something to relieve your mind forever of a great bugaboo, unwanted water, is here . . . A centrifugal pump as

advanced as your latest steam shovel is over the nigger with the spade . . . A centrifugal pump that will pass larger solids than any other of its size on the market today . . . A centrifugal pump that will pick up a twenty-eight foot suction lift . . . will take air along with water . . . will pick up its prime and hold it . . . A centrifugal pump that will take your water out and keep it out . . . A centrifugal pump without priming pumps or attachments or any trick gadgets . . . a pump that you have dreamed about . . . that you truly deserve . . . and a pump that deserves its name . . . HUMDINGER.

ated is entirely independent and is not affected by the power required to propel the truck. When one motor is used, the speed at which the rotors operate is dependent upon the acceleration, and the gear ratio in which the truck is operated. These factors in turn, are dependent upon the varying power required to operate the rotors and the varying power required to force the snow plow into the snow. With the various snow conditions encountered it is frequently necessary, especially in deep snow, to slip the clutch to give the rotors of the

MEDIUM BAJE
PORCELAIN RECEPT L

9 OR 14" PARABOLIC
MIRRORED PROJECTOR
500 OR 1000 WATT
MULTIPLE LAMP

TILTING
ADJUSTMENT

HORIZONTAL
ADJUSTMENT

LANTEEN SET TO ANY
POSITION ON ADAPTER

King Luminaire

snow plow an opportunity to accelerate and clear the snow away from the plow before proceeding.

The controls in the cab of the truck are conveniently arranged so as to provide full control of the two motors, the driving mechanism, and snow plow, by the driver.

On the dash of the truck there are two ignition switches and two starter buttons. There is an extra clutch pedal placed beside the regular clutch pedal to operate the clutch on the rear motor. Two control sets are provided side by side, for operating the transmissions, that are connected with either motor. A short lever placed next to the control set operates a safety device permitting only one of the motors to be used at one time to propel the truck. The foot accelerator is connected to the throttle of the carburetor of the rear motor, while the hand throttle controls the valve of the carburetor used in the regular motor.

#### King Ornamental Lighting Equipment

The King Luminaire Co., 53 W. Jackson Blvd., Chicago, Ill., manufactures King Special Lighting Equipment which consists of two designs or types of ornamental lanterns, each design made in two sizes. The lanterns

and equipment are standardized and interchangeable.

All metal parts are made of silicon aluminum alloy, non-corrosive, and having a tensile strength of 30,000 lbs. to 35,000 lbs., assembled with brass screws throughout. The patented method for holding the glass panels is a special feature. The design consists of a double weather-proofed spring bronze strip, groove like on each side extending the entire length of the rail for gripping the edges of the glass panels with uniform tension from top

to bottom. When the top is raised, each panel may be instantly removed or put back in its place by sliding up or down. This method reduces maintenance cost to almost nothing, eliminating the old method of using felt, springs and screws.

By placing a lamp on the back of the projector, as well as on the front, the shadow carried by the projector is practically eliminated and a general lighting effect is obtained in addition to the floodlighting of a special object.

Small size floodlighting equipment for 10-AF and 13-AF (small lanterns), consists of universal a djusting frame equipped with 9-inch parabolic mirror diffusing projector with

mogul multiple socket for 500 watt lamp in front of the projector and medium base multiple socket for 100 to 200 watt lamp behind the projector. Assembled

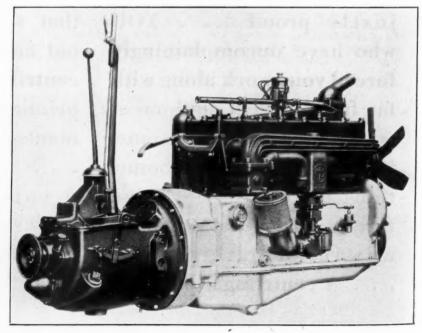
and wired with asbestos covered wire; complete except lamps.

Large size floodlighting equipment is furnished for 10-BF and 13-BF (large lanterns), consisting of universal adjusting frame equipped with 14-inch parabolic mirror diffusing projector with mogul multiple socket for 1,000 or 1,500 watt lamp in front of the projector and medium base multiple socket for 100 to 200 watt lamp behind the projector.

Glass panels are either Syenite or Astralite; or panels for special distribution where required are provided.

#### Mack BC High Speed Motor Truck

The latest model of Mack trucks to be placed on the market, known as Model BC, is a six-cylinder truck designed for service requiring power, capacity, and high, safe speed. The engine has a combined fan and water pump mounted at the front of the cylinder block, both driven from the one belt; crankcase ventilation provided by a flexible tube extending from the valve cover plate to the elbow on the carburetor intake; throttle control of the exhaust heat applied to the inlet manifold through a jacket on the riser; and thermostatic temperature control. There is a by-pass to the path of the cooling water through the jacket space. When the temperature of the jacket water drops below 150 degrees, no water circulates through the jacket and circulation begins again when the jacket temperature rises above 175 degrees. Another interesting feature of the engine is a high-pressure lubrication system which operates under a pressure of 55 pounds per square inch and extends to main, connecting rod and camshaft bearings. An H-W filtrator is included in the oil circuit.



Six-cylinder Power Plant for Mack BC Truck

# COLPROV

The process which eliminates the use of heat and volatiles in the preparation and laying of all types of asphaltic road materials.



Colprovia Pavement on State Highway at New Britain, Connecticut

### Colprovia Roads Have Withstood the Heaviest Traffic in England for Upwards of Five Years

First Colprovia Road Laid in United States, May, 1927

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### **COLPROVIA**



ROADS, Inc.

Laboratory: 20 West 22nd Street New York

52 Broadway, New York

Southern Office: 231 Healey Building Atlanta, Ga.

With a bore and stroke of 3¾ in. x 5½ in., the BC engine develops 100 horsepower at 2400 r.p.m. The six cylinders are cast in a single block with a separate single head. Pistons are made of low-expansion aluminum alloy. Connecting rods are tubular, machined all over and are made of drop forged molybdenum steel. The crankshaft is mounted in seven main bearings three inches in diameter. The camshaft, which is 1¼ in. in diameter, is mounted in four bearings. The valves have flat seats and are located on the right-hand side. Inlet valves are made of chrome-nickel steel and exhaust



Beaver Grooving Tool

valves of chrome-silicon steel. A mechanical vacuum booster pump is mounted on the crankcase on the right side and forward of the carburetor.

Ignition is by battery and distributor with semi-automatic advance. The electrical system is of the 12-volt type and of North-East make.

The clutch on the new model is of the Mack single plate, dry type, with the clutch housing and transmission bolted to the crankcase to form a unit power plant. The transmission is a four-speed unit with direct-drive on fourth. All spring tips, the radiator, steering column and cab are rubber shock insulated. Four-wheel internal brakes are supplemented by a vacuum booster attachment, by means of which tremendous power may be exerted on all four wheels with but little effort on the driver's part. Hand brake is mounted independently on the drive shaft. The total braking area is 750 square inches. The Mack Company states that the truck not only has great pulling power, but is capable of sustaining the speed of ordinary passenger car traffic.

### Centaur Highway Mowing Unit

The Centaur Tractor Corporation, Greenwich, Ohio, Manufacture the Centaur highway mowing unit, which is handled by the Centaur tractor. The Centuar tractor is powered by a 12-horse power Le Roi motor, two cylinder, equipped with a high tension magneto, Zenith \_\_rburetor and Pomona air cleaner which fully protects the motor from dust and dirt.

The cost of operation, it is said, will run from four to six gallons of gasoline per day for ten hours of work. The amount of highway that can be properly handled would range from ten to twenty miles.

Any standard make of mowing machine equipped with rubber tires can be fitted to the Centaur; but it is specially planned for the Big 6 I. H. C. built by the International Harvester Company, who have made a special design of this and strengthened the parts. Therefore, the use of this machine is recommended. Other than adding rubber tires and a special lever for raising the cutter bar from the cement in order to prevent wearing of the shoe the mower is standard.

The speed of the outfit will range from two to four and a half miles per hour or it might be run at a higher rate of speed; however, the experience has been that four to four and a half miles an hour obtains the longest life for the cutting unit.

### Beaver Grooving Tools for Victaulic Joints

The Borden Co., Warren, Ohio., has brought out a set of tools for grooving pipe ends, ½-inch to 16-inch, to take Victaulic couplings. A point of importance in these tools is the device whereby a circular groove is cut, even though the pipe is out of round.

There are three different patterns, as follows: No. 12, the small tool for hand operation only, which is both a grooving and a cutting-off tool. Unlike the larger Beaver grooving tools this tool does not lock on the inside of the pipe nor operate from a central axis. The No. 12 tool cuts a groove which conforms to the contour of the pipe end, but this is not a disadvantage on the small sizes where the error at no time could be great or consequential. The No. 12 will not only groove pipe, but may also be used as a square-end pipe cutter.

Beaver grooving tools 20 and 50 are alike in design. A threaded bolt goes through the center of the tool, over which is placed a double-ended cone on either side of which there are four links

which are expanded by the cone when the bolt is tightened. This forms a perfect grip and holds the tool rigid in the pipe. The groove may then be cut by either hand or power operation, and the work may be done anywhere — at the bench, down in a ditch, etc. One man operates these tools easily—although it will be found more satisfactory to use a power drive.

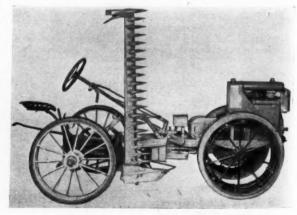
Beaver grooving tools 120 and 160, grooving 8-inch to 12½-inch and 14-inch to 16-inch respectively, are of large size. A different type of

internal locking device is desirable. The tool is placed on the pipe and the internal locking arms rigidly held in position by means of tightening the nut on the front of the tool. In these larger tools—as in the Nos. 20 and 50—the groove cut is a perfect circle regardless of the fact that the end of pipe itself may be out-of-round, which is usually the case. Because of the weight of these tools, two men are required to place them on the pipe. After being put in position, however, one man readily can operate the grooving tool. Because of the greater speed of operation, the use of Power Drive is recommended.

### Prest-O-Weld Two-Stage Oxygen Regulator

The Oxweld Acetylene Company, 30 East 42nd Street, New York City, has added to the Prest-O-Weld line a two-stage oxygen regulator, designed to eliminate fluctuation in working oxygen pressures. This regulator, which is designated the type R-109, incorporates the stem-type valves, which have proved extremely satisfactory in single-stage regulators.

The chief feature of the improved design is two-stage pressure reduction, accomplished through the medium of two independent sets of diaphrams, valves and springs. Instead of reducing the full cylinder pressure of about 2,000 lb. per sq. in. down to working pressure, which is often only a few lb. per sq. in., in one stage, the R-109 regulator reduces through this wide range in two stages. In the first stage the cylinder pressure is reduced through a non-adjustable reducing valve to about 175 lbs. per sq. in. Leaving the first stage the oxygen passes to a second valve and diaphragm assembly, where the pressure is reduced to that desired by the operator, the second-stage reducing valve being adjustable by means of the hand wheel. Thus, instead of reducing the full cylinder pressure to working pressure, the second stage is required to regulate pressures within only a narrow range, which it can do easily and efficiently.



The Centaur Highway Mowing Unit will mow 10 to 20 miles daily

### Because-

The entire Barrel is Removable

A Broken "MATHEWS"

can be replaced

### WITHOUT EXCAVATING

The number of nozzles can be changed

### WITHOUT EXCAVATING

The nozzle direction can be changed

### WITHOUT EXCAVATING

The nozzle levels can be raised or lowered

### WITHOUT. EXCAVATING

Write for a complete description

Manufactured by

### R. D. WOOD & CO.

Established 1803

### **PHILADELPHIA**

Cast Iron Pipe and Fittings

Sand Spun (centrifugally cast) and Pit Cast "Reg. U. S. Pat. Off."

### Exhibits at the Road Show

Orton 5/8-Yard Shovel Powered With Six-Cylinder Engine

The line of crawling-tread excavators manufactured by the Orton Crane & Shovel Co., 608 Dearborn St., Chicago, Ill., will be represented at the Road Show, booth 308 in the main auditorium, by a Model "Al" 5/8-yd. shovel.

This machine is the first small-capacity excavator to be equipped with Engine Co.

The exhibit of the Stover Mfg. & Engine Company of Freeport, Ill., at the Road Show, held at Atlantic City

Stover Manufacturing &

the Road Show, held at Atlantic City in January, will feature at this year's exhibit the Stover Vertical-type power units, which can be had in either single, double or four cylinder types, with both hopper and radiator cooling systems. They are offered with either crank-shaft take-

off, to operate at full engine speed; or cam-shaft takeoff, to operate at half engine speed, as well as many m o d i f i c a tions in speed takeoffs. The circulating splash system lubrication is employed, the lowpart of the crank case serving as an oil reservoir. A plunger-type oil pump, completely submerged, draws the oil from the reservoir through a screen and de-

livers it under pressure to cam-shaft bearings, timing gears, and the enclosed governor parts.

Also the new and refined Horizontaltype completely enclosed Stover Engine of the "C. T." type will be on display. On this series of power units all oilholes or cups are dispensed with, and an automatic lubricating system provides for the constant, automatic distribution of the oil to all working parts.



Orton %-Yard Excavator

a six-cylinder gasoline engine. The latter is of the standard heavy-duty type, rated at 56 hp. at 1400 r.p.m., and is connected to the operating mechanism by means of a roller-chain drive. Other interesting features of the machine are the positive gear-driven crowding mechanism, the self-cleaning spring-type crawling treads, and the cab construction which gives the operator a clear view on what is ordinarily the blind side of a machine.

The shovel can be converted to a crane, dragline, skimmer or ditcher, and one of the ditcher attachments will be exhibited. There also will be shown a Model "E" excavating clamshell bucket as typical of the Orton line of excavating and material-handling buckets.

Among the Orton representatives in attendance at the Road Show will be: P. A. Orton, Jr., 'Vice-President and Sales Manager; and A. R. Whitney, of the Chicago office; S. R. Vanderbeck, of Philadelphia; H. W. Hegemen and John M. Connell, of the Mott & Mc-Elrath Engineering Corp., New York; A. H. Krigger, of Pittsburgh; B. L. Whitney, of Detroit; W. D. Tulley, of St. Louis; Stuart S. Smith, of San Francisco; Leigh M. Railsback, of Los Angeles; Alex Orton, Works Manager, and F. D. Small, Service Engineer, of Huntington, Ind.

### The White Company Truck Exhibit

Three newly developed White trucks. all designed specifically for highway construction and maintenance work, will be exhibited by The White Company at the annual convention and road show of the American Road Builders' Association which opens in Atlantic City on January 11. The exhibit in Space 144 will include:

White Model 58, heavy duty dump truck. This model has become one of the most popular dump trucks in the White complete line, because of its power and speed. Most high speed dump trucks are designed for material hauling only to meet the increasing demand in road construction and maintenance and are not adaptable for excavation and grading work because they do not have sufficient power. In the Model 58 dump truck is offered a high speed pneumatic tire unit which fills all the requirements of road building.

White Model 61 dump truck. One

White Model 61 dump truck. One of the new White six-cylinder light duty trucks especially adaptable for road maintenance work and the lighter dump truck construction work.

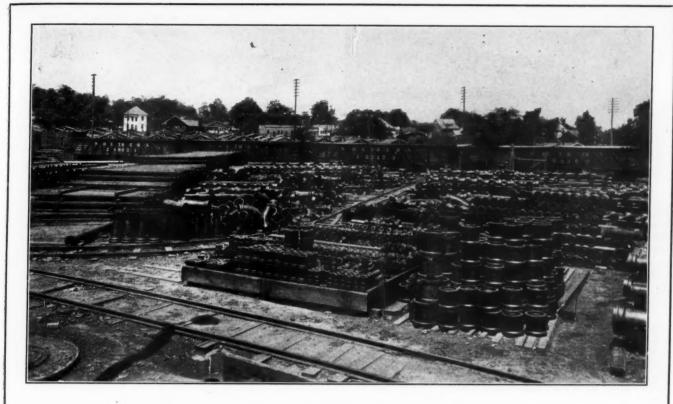
White Model 59 heavy duty chassis. A custom built heavy duty chassis powered with a 100-horsepower motor for the unusual jobs of construction and maintenance, especially suitable because of its ability to transport maximum gross loads for long distance hauling of road materials with truck and trailer. Its power also makes it adaptable for tractor work in operation with drop frame trailers for the hauling of heavy road machinery, snow plow work or in the maintenance of gravel roads.

Representatives of The White Com-

Representatives of The White Company who will attend the convention



White Model 59 Motor Truck



### **Precalked Fittings Too!**

The best of pipe is useless for service without fittings.

We specialize on giving good service on McWane Precalked Joint Fittings, in order that installation of pipe will be expedited.

The picture above shows part of the McWane shipping yard devoted to fittings, at one plant.

Precalked Joint Fittings are an exclusive and important McWane Pipe accessory. They enable you to lay *all* your main without recourse to the cumbersome lead-pot. If you are going to free yourself of the lead-pot, go ALL the way by using McWane Precalked Joint Cast Iron Pipe *and* Precalked Joint Fittings, too. Each perfects the other.

McWane Pipe sizes: 1¼ thru 12 inches. Standard lengths. Also furnished without Precalked Joints. B. & S. type.

### VERY SMALL CAST IRON PIPE

Cast iron pipe of McWane make, in sizes as small as 1½ and 2 inches, is being increasingly used for services, small mains, parallel mains, filtration and sewage disposal plant piping, and for irrigation systems in golf courses, parks, and cemeteries.

Wherever permanence with low cost is desired, small cast iron pipe is best. The famous McWane Precalked Joint makes laying it swift and simple.

Most years of service per dollar.

### WRITE FOR ILLUSTRATED LITERATURE

McWANE CAST IRON PIPE CO. BIRMINGHAM, ALA.

PACIFIC STATES CAST IRON PIPE CO.

SALES OFFICES IN PRINCIPAL CITIES







White Trucks in use by City of Cleveland. At left, garbage trucks; at right, engaged in snow removal

are .Robert W. Woodruff, president; Saunders Jones, vice president and assistant to the president; W. A. Maynard, H. P. Starbird, R. W. Knowles, J. M. Bauman, C. I. Fraley, G. R. Gwynne, R. J. Logan, R. Lapham and R. E. Laisy.

### MultiFoote Pavers Exhibit

The Foote Company, Inc., of Nunda, N. Y., will exhibit in Booth 211 at the Atlantic City Road Show, the 1930 Model MultiFoote Paver.

The 1930 MultiFoote holds to those same general features of construction which have proven so dependable in the past but introduces several new refinements and improvements designed to make it a still faster and more dependable machine.

Principal among these new features are the simple new device for automatically closing the discharge chute when the loading skip is raised to charge the machine; a change in the design of the loading skip which further increases the charging speed, and the change from a "low pressure" to a "no pressure" water measuring tank.

On the 1930 MultiFoote all pressure is removed from the water measuring tank which is filled by gravity from an open top auxiliary tank mounted above it on the machine. The flow of water into the auxiliary tank is controlled by a disc type float valve in the

supply line. Accurate water measurement under all conditions of grade and regardless of line pressure or air in the supply line is thereby assured and no damage can result from excessive pressure.

The new MultiFoote contains every proven, practical, automatic feature without complicated mechanical devices.

### Littleford Bros. Shows New Equipment

Littleford Bros., Cincinnati, Ohio, are located in the very center of the Exhibition Hall. L. W. Glaser is master of ceremonies and extends a hearty invitation to visit Booth 507-521.

High lights in the Littleford exhibit are the new High Speed Maintenance kettle and the advanced Motor Driven Spraying Attachment for penetration and skin patching, shoulder work, widening of curves and crank filling.

Other equipment to be seen in the Littleford booth includes: The No. 84-WS, an oil burning maintenance kettle of 50-75 gallon capacity; No. 98, the new LB Surface Heater; the All-Steel Heavy Duty Tool Box. A small stationary box is also displayed. The widely used LB Trail-O-Heater and the new Universal Concrete Heater Attachment complete the exhibit.

### Four Wheel Drive Auto Company

The Four Wheel Drive Auto Company will exhibit at the annual Road Builder's Association Convention. Their space, number 228, is on the main floor of the auditorium, and two trucks will be on exhibit. One of them will be a Commercial Utility Six, equipped with pneumatic tires, 3-yard body, enclosed cab, rear view mirror and windshield

wiper. It is to be painted in red, black and green. The other truck will be the CU's running mate, the Model H. It will be equipped with 34 by 7-inch pneumatic tires, 2-yard body and accessories similar to the CU.

### Blaw-Knox Exhibits at the Road Show

The Blaw-Knox Company will exhibit the following items of equipment at the Road Show in the Atlantic City Auditorium, January 13th to 18th inclusive.

A 51-ton all steel, portable two compartment, self cleaning Batcherplant equipped with a Duplex Weighing Batcher.

A three compartment Blaw-Knox Self Cleaning Bin of 100 tons capacity, equipped with a Triple Weighing Batcher.

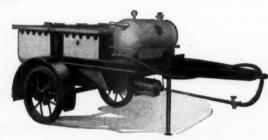
Both of the above bins contain an operating platform for the weighing equipment. The weighing hopper and the scales are transported as a unit with the bin, or attached to it. With this arrangement there is no need for dismantling for erection of the weighing batcher or the scale mechanism.

A Blaw-Knox Cement Weighing Batcher erected on an operating platform will also be exhibited.

The Blaw-Knox Agitator Truck Body will be shown in operation on the motor truck this year. The Blaw-Knox Agitator Body hauls the concrete from the ready mixed plant to the

job, and absolutely prevents segregation of the aggregates.

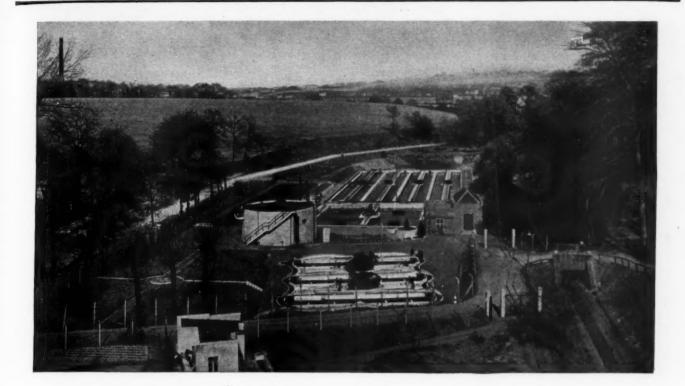
Agitation of the concrete permits quick discharges from the truck body at the job, thus permitting a considerable saving in truck time and cost of operation. These bodies can also be used for general hauling purposes for sand, stone, gravel, coal, etc., without the removal of the agitating mechanism.





Littleford
Equipment:
Atleft, Tool
Box; above,
84-WS; at
right, Surface
Heater





# The Ruhrverband will use Dorr Equipment

Pictured above is the well-known Essen-Rellinghausen sewage treatment plant of the Ruhrverband, in Essen, Germany.

This plant for some time has not had sufficient presedimentation capacity. To rectify this condition it was decided to install a large Dorr Traction Clarifier equipped with skimming device. For digesting the sludge from the Clarifier a Dorr Gas Collection Type Digester will be used. The Ruhrverband are also installing a Dorr Traction Clarifier and a Dorr Digester at their new Witten plant.

The selection of Dorr equipment by the internationally known Ruhrverband is a gratifying indication of the reputation that Dorr equipment has earned in the sanitary engineering field.



If you are interested in sewage treatment or water purification you should have a copy of our new bulletin "Modern Sanitary Engineering Practice." Our nearest office will gladly send you a copy.

DENVER, COLO.
1009 17th Street
CHICAGO, ILL.
333 North Michigan Avenue
LOS ANGELES, CAL.
108 West 6th Street
WILKES BARRE, PA.
Miners Bank Building
JOPLIN, MO.
319 Joplin National Bank

Building

ATLANTA, GA. 1503 Candler Building THE DORR COMPANY

ENGINEERS

247 PARK AVENUE

**NEW YORK CITY** 

INVESTIGATION

**TESTS** 

DESIGN

**EQUIPMENT** 

MELBOURNE, AUSTRALIA Crossle & Duff Pty., Ltd., 360 Collins Street TOKYO, JAPAN Andrews & George Co., Inc., Central P. O. Box F-23 TORONTO, ONT.
330 Bay St.
LONDON
The Dorr Company, Ltd.
Abford House, Wilton Rd.
S. W. 1
BERLIN
Dorr Gesellschaft m. b. H,
Kielganstr, 1 W. 62
PARIS
Societe Dorr et Cie
26 Rue de la Pepiniere
JOHANNESBURG, S. A.
E. L. Bateman
Locerno House.

Both high lift and low lift hoists will be demonstrated at the exhibit.

The Blaw-Knox Dreadnaught Road Form will also be exhibited.

Blaw-Knox will also exhibit its steel street forms (Universal Forms) showing the system of forming sidewalks, curbs, integral curbs, curb and gutter, radius forms, both flexible and rigid, etc. Actual set-ups of these forms with stakes for bracing high curbs involving battered face where poor soil conditions exist, will be shown.



Koehring Dumptor

A Blaw-Knox one-yard Inundator and water measuring equipment will be exhibited on a frame exactly as it is arranged on a life size Inundation Plant on the job. The complete piping, valves, water tanks, etc., are included in this exhibit so that the observer can follow the entire method and sequence of the operation; also the manner of operation of a central mixing plant.

Blaw-Knox Electroforged Steel Grating will be exhibited as an integral part of the exhibit set-up. This grating will be used for stair treads, platforms and elevated walk ways.

Blaw-Knox Floorgard, a steel reinforcement for the armoring of floors, and Blaw-Knox Pavegard, a steel reinforcing for the armoring of streets, will also be exhibited.

A complete line of Blaw-Knox Clamshell Buckets and Blaw-Knox Dragline Puckets will be on display.

A special rack has been built to show the Blaw-Knox Ball Bearing Dreadnaught Bucket in operation.

Models of Blaw-Knox Turntables will be shown.

The exhibit of the A. W. French Company division of the Blaw-Knox Company will be an integral part of the Blaw-Knox exhibit and the following equipment will be on display: The Ord Finishing Machine will be

The Ord Finishing Machine will be shown in actual operation, mounted on side forms and will demonstrate all the operations involved in the finishing of a concrete highway.

There will also be on display an

asphalt fluffing attachment for the Ord Road Finishing Machine.

The Nu-Method Finished Grader. This machine planes the sub-grade and discharges any excess material to the side of the road by means of a belt conveyor. This is a very interesting piece of equipment for the contractor who is particular about his costs and who is anxious to produce his job with the greatest possible saving in labor and materials.

The Ball Wagon Grader will be on exhibit. The Ball Wagon represents the latest development in earth moving equipment. It will be interesting to all contractors who contemplate having jobs which involve the moving and spreading of dirt.

### **Huber Motor Rollers**

The Huber Manufacturing Company, Marion, Ohio, will exhibit a 10-ton and a 5-ton four-cylinder motor roller.

Both of these rollers will be equipped with new improved scarifiers—a marked improvement over scarifying equipment now available.

The exhibit will be in charge of M. E. Miller, Sales Director of the company. Several branch house managers and field men will be in attendance to assist in welcoming all visitors.

### Rome Manufacturing Company

The Rome Manufacturing Company, Rome, New York, will exhibit a number of models of Rome "High Lift" Graders at the Road Show. The exhibit will be located in space 669-672.

In the Rome line of "High Lift" graders, will be found incorporated all the latest improvements in road graders, as originally adopted by the Rome Manufacturing Company. G. D. Finney, sales manager, reports that sales for 1929 are far ahead of any preceding year.

A cordial invitation is extended to all attending the Road Show, to visit the Rome exhibit and make an inspection of Rome "High Lift" graders. E. C. Gledhill, the inventor and designer of Rome "High Lift" Graders, will be in charge of the exhibit, assisted by various members of their organization. After closing hours, members of the Rome organization will be found at the Strand Hotel.



Rome Grader

### Koehring Exhibits New Products

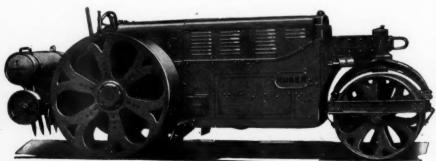
Koehring Company, Milwaukee, Wisconsin, will include two new products, the Dumptor and the 401 Shovel, in its large exhibit at the Road Show in Atlantic City, January 13-18.

The Dumptor is the latest addition to the Koehring Heavy Duty line of Pavers, Mixers, Shovels, Pull Shovels, Cranes, Draglines, and is distinctly a new load-carrying unit, the first and only one of its kind on the market.

To its line of Shovel-Crane-Dragline excavating equipment the Koehring Company has added a new model—the No. 401 which will also be shown at Atlantic City. The Koehring 401 Heavy Duty Shovel has a one yard dipper on 16-foot dipper sticks. When built as a crane, it has a capacity of 13 tons at 12 foot radius with a 50% safety factor.

In addition to several distinctive Koehring features, the new 401 embodies an outstanding change in design which heretofore has never been incorporated in a machine of this type. All the gears, except the turntable gear and swing pinion, are enclosed and run in oil. All the machinery shafts, which enter into the operations of hoisting, drag, dipper crowd, boom hoist and swing, are mounted on roller or ball bearings.

The Greater Koehring 27-E Paver will be another center of outstanding interest at the exhibit. Brought out a year ago, this paver proved itself during the past season to be an achievement in fast operation. Each one of the many extraordinary features, inclding the automatic operations, has been developed in accordance with the Koehring principle of Heavy Duty construction. Every bearing in the



Huber Motor Roller

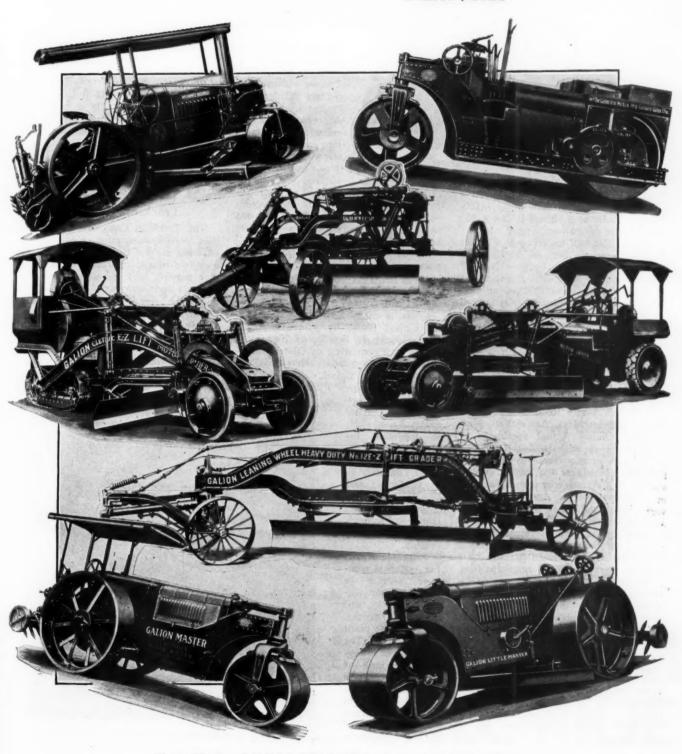
### SEE GALION

### AT THE ATLANTIC CITY ROAD SHOW

The most complete and up-to-date line of Road Machinery at the Show will be found in the Galion Exhibit, Spaces 430 and 481.

You are especially invited to make our exhibit your headquarters during your stay in Atlantic City.

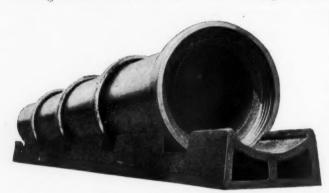
THE GALION IRON WORKS & MFG. CO. GALION, OHIO



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whole power transmission line—skip hoist, drum drive, boom and bucket drive, even idler sheaves and bucket rollers are mounted on roller or ball bearings.

Other Koehring products to be found in space No. 340 are the Heavy Duty Shovel No. 601 and the Heavy Duty Crane No. 301. The 601 Shovel is the largest Koehring excavator and is built with a 1½-yard dipper on 16-foot dipper sticks. It is powered with a Wisconsin six cylinder 6"x7" engine, running at 925 R. P. M. The 301



Ric-wil Sewer Cradle Base

Crane has a capacity of 10 tons at at 12 foot radius with a 50% safety factor. Built as a shovel it has a 34-yard dipper on 16-foot dipper sticks.

The exhibit will be grouped with the Insley Excavator, the new Smith 84-S Weigh-Mix, the new Parsons No. 25 Ditcher and the Kwik-Mix tilting mixer to form the National Equipment Corporation display, which will be located on the stage, main floor, of the Auditorium.

### Armco Culvert Exhibit

Drainage products and methods of special interest to municipal officials and public works contractors are exhibited in this year's Road Show by the Armco Culvert Mfrs. Association, Middletown, Ohio. Actual specimens of pipe combined with explanatory films and charts give a complete picture of the uses, advantages and methods of installation of Armco corrugated iron pipe in municipal work. Armco Paved Invert Pipe and the Armco Jacking Method are especially featured.

Because of the Armco Jacking Method of culvert placement having been adopted as standard practice by a number of railways and municipalities, a special effort has been made in this exhibit to explain its many advantages. Those who are interested in culvert placement methods, either from the standpoint of the public official or that of the contractor, will find a visit to the Armco exhibit to be time well spent.

The Armco exhibit is in space 103 with Anton S. Rosing, Publicity Manager, in charge. Other Armco representatives in attendance are H. E. Cotton, A. J. Gloyd, J. B. Morrison, Mont C. Noble, Howard See, and W. H. Spindler.

#### Colas Exhibit

In Space No. 472 at the 1930 Convention and Road Show of the American Road Builders Association, engineers and contractors will have an opportunity to get information on a new road binder which has been used for several years in England and on the continent. Colas, as it is called, is an unfluxed straight run emulsion of pure asphalt which can be applied in any weather when the temperature is above freezing. Since it is used cold it re-

quires neither an elaborate plant nor highly skilled labor. It is based upon two fundamental factors. First, that asphaltic bitumen is the best road binder so far discovered. Second, the Colas Process insures a perfect relation between binder and aggregate, as this emulsion penetrates into every creviceanywhere water can go -- sealing each particle of stone

with a film of pure asphalt. This binds the aggregate of the entire construction—foundation, base and surface into one unit. The deep penetration of Colas precludes the possibility of "bleeding," or pushing into "waves" in warm weather.

Colas roads may be used immediately after completion; there is no "pick up" or "tracking;" they are non-skid.

Colas is manufactured and sold in the United States by Flintkote Roads Inc. Col. H. L. Bowlby of New York with a staff consisting of District Managers V. L. Ostrander, New England and New York, and R. G. Wace, Toronto district; Sales Engineers, O. H.

Kollock, So. Carolina; R. M. Littlefield, Boston; K. S. Bowman, Indianapolis; E. D. Crumb, Ithaca; Chief Chemist, T. F. O'Meara; and C. W. Perry, a mechanical expert from England, will be at the convention.

Flintkote Roads Inc., offers a complete service to road builders, including tanks, and pressure trucks. No elaborate plant is necessary. The widening of a 31/2mile section of narrow concrete road, using Colas, was described in the September, 1929, issue of PUBLIC WORKS.

This widening, which cost \$3,500 per mile, was done without any interference with traffic. The equipment used was simple.

#### Ric-wiL Sewer Cradle Base

The Ric-wil Company, Union Trust Building, Cleveland, Ohio, will feature at its exhibit, Space 413, Exhibition Hall, at the Atlantic City Road Show, Ric-wiL Cradle Base Drain, a tile foundation and drain for sewer systems that adds 82% to the crushing strength of sewer pipe. This additional strength is brought about through the unique design of the cradle by which it distributes the load, transmitting it through a perfectly rigid construction to a firm foundation or solid ground unweakened by sub-drain. Sewer pipe is simply set in place on the base drain and joints are easily caulked and sealed. Cradle Base Drain speeds the entire job because of no field construc-

Other Ric-wiL products which will be shown at their Road Show exhibit are Cast Iron Ric-wiL Drain, Cast Iron Culvert Pipe, Ric-wiL Sewer Joint Compound and line of accessories, and Ric-wiL Impregnated Tape.

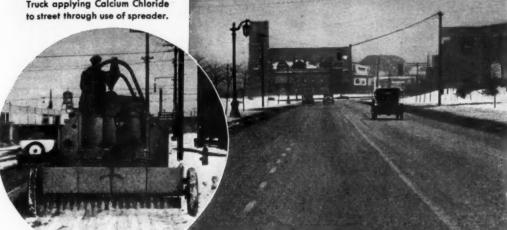
### Trackson Company

The Trackson Company, Milwaukee, Wis., will have a number of surprises in store at the 1930 Road Show for everyone who is interested in highway, dirt moving and general construction methods and equipment. Four entirely new machines,—the new Trackson Crawler for the 15-30 McCormick-Deering Tractor, Trackson Crawler Wheels, the Trackson Hoist and the new Trackson Shovel—will be introduced in their display which will be located in Section 102, on the main floor. The appearance of these new



New Trackson Shovel

Truck applying Calcium Chloride to street through use of spreader.



View of the Boulevard in Cleveland after being cleared of ice by application of Calcium Chloride.

Calcium Chloride was spread on this Lake Avenue, Cleveland, bus stop. Note how traffic has spread it. clearing one side of street,

# This Way to Remove ICE

.. is made to order for today's smooth streets and fast, heavy traffic . . .

DOADS are only as good as the maintenance they get... Methods of ice removal considered good enough for the dirt and cobblestone roads of the last decade do not measure up to the requirements of the roads and streets of today.

For when ice forms on the surface, the smoothest road becomes the slipperiest, and since the best roads attract the heaviest traffic, dangers multiply.

But the simple and inexpensive application of Calcium Chloride to such a surface takes advantage of every factor in the situation. Traffic helps distribute the Calcium Chloride, which quickly

honeycombs and melts the ice. The resulting water is speedily carried off by natural drainage and the surface is left in a safe riding condition.

Cities and railroads today find many uses for the ice-removing action of Calcium Chloride, such as keeping grades, turns, bus stops, stop streets, car tracks, and third rails free from ice; thawing sewers and catch basins.

Write today to any member of the Calcium Chloride Publicity Committee regarding your special problems of ice removal. Full information applicable to your individual case will be furnished promptly. Ask for booklet 841

### CALCIUM CHLORIDE PUBLICITY COMMITTEE

OPERATING UNDER U.S. PATENT NO. 1,527,121 THE COLUMBIA PRODUCTS COMPANY, Barberton, Ohio THE DOW CHEMICAL COMPANY, Midland, Michigan SOLVAY SALES CORPORATION, 40 Rector Street, New York

## CALCIUM LORIDE

machines has been long and eagerly awaited, and they will undoubtedly be the center of much lively interest.

While the new crawler for the 15-30 McCormick-Deering is typically Trackson design, nevertheless it is a distinctive type of crawler and has a number of special features which are entirely exclusive. It is designed for highway and general contracting work, and will also have a wide range of usefulness for other fields.

The new crawler wheels will be produced in four sizes, with six, ten, fifteen and twenty-ton load capacities, respectively. The 10 and 15-ton sizes will be of particular interest to dirt moving contractors, since they can be used on wagons with from 5 to 10-yard capacities.

The Trackson Hoist is of all-steel construction and has several new patented features which are absolutely exclusive, and which combine to make it the ideal hoisting equipment for all kinds of work. It is designed for mounting either on Trackson Crawlers or on wheel tractors.

The new Trackson Shovel was built by the Trackson engineers only after a very thorough study of the needs of contractors, industrial plants and others who dig and handle various kinds of materials. Its outstanding features are extraordinary strength of construction, a sharp cutting edge which enables the bucket to dig into hardpan, rocky soil, etc., simplicity of operation, interchangeability with the Trackson Bulldozer and Crane, and extremely low overhead clearance. The

latter is especially important for material-handling operations in industrial plants where the unit works indoors as well as in the yards.

The new Shovel will be displayed at the Road Show mounted on a Trackson Crawler-tractor. It may also be mounted on the wheel tractor, but the crawlers are recommended for work in soft, loose, or slippery ground.

In addition to these new machines, the Trackson Company will exhibit several Model L Tracksons which are the ideal crawler tractors for use with oneman graders and other road machines, a Model DH Trackson McCormick-Deering equipped with the Trackson Bulldozer, a Trackson Crane mounted on a McCormick-Deering wheel tractor, and several other pieces of Trackson Equipment.

The Trackson display in Section 102 will be in charge of L. E. Dauer, Sales Manager. Others in attendance will be W. H. Stiemke, Vice-President and General Manager, R. D. Houghton, R. G. Brunner, J. L. Hawes, and several other representatives of the company.

### Wallace & Tiernan Exhibit

Wallace & Tiernan Co., Inc., of Newark, N. J., at their booth exhibit their complete line of highway flashers as well as several pieces of new equipment in the marine signal field.

A feature of their exhibit is the effective demonstration of the internal mechanism of their various types dry battery operated flashers. The following

is a description of other equipment at the Wallace & Tiernan booth:

W & T Standard One-Way Flash, reliable, efficient and economical, for stop streets, curves and dangerous road conditions.

W & T Universal Flasher gives 35 flashes a minute of the distinctive fresnel beam. For center of the street or safety isle installations.

W & T One-Way Railroad Flasher. Special grade crossing warning signal, developed in cooperation with the Pennsylvania State Highway Department. A flashing illuminated railroad cross buck gives positive warning signal to traveling public of grade crossing.

W & T Octagonal Stop Street Flasher, Pacific Coast type. Standard design for stop street signs for Los Angeles, San Francisco and the State of California. 300 of this type now being installed in Orange County, California.

W & T Universal Over-Head Flasher. Self-contained unit, ideal for narrow intersections. Orienting cable hanger furnished so that the side of the case can be lettered. Equipped with relay flasher and automatic lamp changer mechanism, giving 32 flashes, visible for the full 360°.

W & T Universal Marine Flasher. New type of Universal Marine Beacon. Has the latest type of relay flasher and automatic lamp changer mechanism which is not affected by motion or position. Five to ten mile range of visibility. Used by the U. S. and British Lighthouse Services.

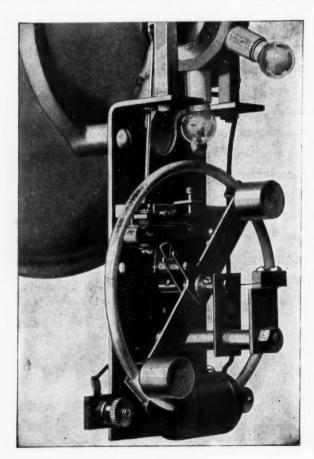
W & T Sunshine Switch Demonstrating Unit. Latest development in sunshine switch which shuts off beacon when the sun shines. Saves 1/3 the cost of operation. Sunshine switch will be in actual operation, controlling a marine beacon. The action of the sun will be simulated by means of a large incandescent lamp.

### **Continental Motors Corporation**

Leading the list of Continental Motors Corporation exhibits in space G259, will be the Model H 24, one of the new series of four-cylinder, s'ow speed type industrial engines. These engines are designed especially for the numerous industrial applications where continuous dependable performance is required.

The new engines are made in eight sizes. They are of the vertical valve-in-head type. Cylinder bores range from 5 to 63/4 inches. Piston stroke is 61/2 in the four smaller sizes and 71/2 in the larger. Horsepower ranges from 39 in the smaller engine to 136 in the larger. Recommended governed speed is 1000 rpm.

Into the design of this series have been embodied such refinements as removable cylinder sleeves, overhead valves, crankshafts with five main bearings, dry sump oiling system, built-ingovernor and longer and better proportioned pistons, all of which increasemotor life and permit many more working hours at minimum cost.





Above: W & T Standard Stop Flasher with reflector buttons. At Left: W & T Lamp Changing Mechanism used with the W & T D r y Battery Lamp Flasher.



The first locomotive cranes manufactured in this country were built by Industrial Brownhoist a half century ago. That these early cranes were good ones is proved by the fact that many of them worked steadily for from twenty to thirty years.

Having a correct design from the very beginning, Industrial Brownhoist has always maintained a large engineering department whose duty it is to know the handling needs of industry and how to meet them. Step by step, a complete line of cranes and shovels has been developed, not in an experimental way, but based on actual knowledge gained from thousands of machines in service.

Today, over 16,000 Industrial Brownhoists have been built, far more than any other make. What more can you ask for in a crane or shovel than a machine backed by such a record?

Industrial Brownhoist Corporation, General Offices, Cleveland, Ohio
District Offices: New York, Philadelphia, Pittsburgh, Detroit, Chicago, New Orleans, San Francisco.
Plants: Brownhoist Division. Cleveland; Industrial Division, Bay City, Michigan; Elyria Foundry Division, Elyria, Ohio.

# INDUSTRIAL BROWNHOIST

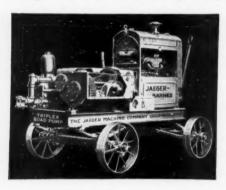
Please Mention PUBLICWORKS when writing to advertisers.

Stewart Nixon will be in charge of the Continental exhibit. Other members of the Industrial Division who will be present during the Show will be L. J. Kanitz, Industrial Division Manager, G. F. Swarthout, Arch Smith, Steve Evelyn, Max Schachner, Arch Sampson, Sid Harris, and A. D. Chandler, Sales Engineers.

### Jaeger Machine Co. Exhibit

Because of their advanced design many items which The Jaeger Machine Company, Columbus, Ohio, will exhibit at the Atlantic City Road Show will be of unusual interest to the industry.

With the 1930 line of Jaeger-Barnes Pumps will be shown the self-priming



Barnes Triplex Road Pump

centrifugal types in which the self-priming device actually increases the pump capacity, particularly at high lifts. Other dewatering pumps, in all types, will include a display of standard diaphragms, convertible diaphragm, lift and force pumps, plunger trench pumps and centrifugals. Road builders, interested in positive water supply, will find the Jaeger-Barnes Triplex Road Pump, completely self-oiling with patented positive rotary oiling pump, Hyatt bearings on all shafts, drop forged crankshaft and 2-piece plungers and cylinder body. The special clutch is of particular value for constant service.

Jaeger Timken equipped Tilting Mixers will be represented by the 3½S Trailer, model 3½CT. Disc wheels with wide cushion tires, and the spring mounted axle used on all Jaeger Tilters, equip it for rough roads and high speed trailing. Jaeger's "one man control" combination of a hoist and mixer will be exhibited in the 7H-4 model one bagger. Featuring the display of non-tilters will be the "Speed King," a full one bag trailer on dual tires and springs.

Bridge builders and others whose specification work is likely to demand rigid control of concrete will center attention on Jaeger's 10S Non-Tilt Mixer in combination with a detached skip scale. This device, built by Winslow, permits quick weighing of cement, sand and stone in the loader. Used in combination with Jaeger's accurate measure water tank it insures water ratio law inforcement.

Timken roller thrust hoists, capacities 10 to 50 h.p., will be exhibited. Posi-

tive screw-thrust control both ways are provided, eliminating springs. Friction clutch and brake are on opposite sides of drums. Optional electric starters are also provided.

The latest addition to the Jaeger line is the Trail or Truck Mixer, produced after two years' study, engineering development and tests. Complete with power plant it can be quickly mounted on any make or model of truck old or new, or on a trailer, and used to haul, mix and discharge concrete, haul and deliver pre-mixed or dry bulk materials.

### Servicised Products Corp.

The Servicised Products Corporation have an exhibit of Premoulded bituminous construction materials particularly adapted to better and safer building of roads, streets, bridges, whether the rigid materials used are concrete, brick or any other form of product which requires protection against expansion and contraction stresses.

In this connection will be shown new forms of expansion joint fillers, pressure moulded from fibrated asphalt; also protection course planking; asphalt planking for bridges; rail filler and track insulation; moulded trunking and capping; tunnel and embankment liners; sewer pipe calking materials; roofing specialties, etc.

The engineers of the Servicised Products Corp. will be on hand in space 608-A for the purpose of demonstrating and explaining the use of fibrated bituminous materials.

### Metalweld, Inc.

Metalweld, Inc., manufacturers of the Metalweld-Worthington line of portable air compressors, are exhibiting their product at the American Road Builders' Convention in space No. 301 on the main floor of the exhibit hall.

They will have on display a working cut open section of one of their 110 cu. ft. Towabout model compressors, and this cut open section will give a very clear view of the working parts of their unit, and the moving parts will forcibly bring before the public eye the mechanical features of their compressor. Among the features emphasized in this working model are

Full Forced Feed Lubricating System, integrally counter balanced crank shaft, large water cooling jackets about the cylinder walls, free floating wrist pin, construction of the electrically lock - welded frame, four ring pistons in the compressor, and especially the Worthington pat-ented "Feather ented Valves" which

are used on all Metalweld-Worthington units. These "Feather Valves" consist of ribbon steel which flex due to the passage of the air and they eliminate the use of springs and also have the advantage of having the lowest replacement cost of any air valve now on the market.

In addition to the above, they will also have on display one of their 330 cu. ft. Towabout compressors. This unit consists of a triplex (3 cylinder) compressor powered by a heavy duty industrial gasoline engine. The unit is sturdily built and carries with it all the advanced mechanical principles of the other Metalweld-Worthington compressors.

### Thew Shovel Co.

The exhibit of the Thew Shovel Co., Lorain, O., at the 1930 road show centers about the new Lorain-75-B heavy duty, diesel-powered shovel, crane, and dragline. This unit is described in detail and illustrated in the Engineering and Construction Equipment section of this issue. Other Thew exhibits at the Road Show will include a 34-yard Lorain-45 and a 1-yard Lorain-55.

### Galion Has Large Exhibit

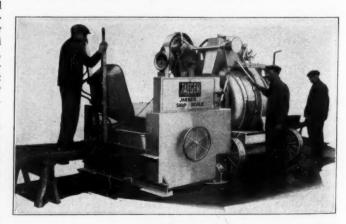
The Galion Iron Works & Manufacturing Company of Galion, Ohio, has a large and interesting exhibit of modern road building and maintenance machinery.

Many new developments and improvements in Road Rollers, Tandem Rollers, Leaning Wheel Road Graders, and Motor Patrol Graders are shown.

The Galion Exhibt is in spaces 481 and 430 with special factory representatives in charge to explain the advantages of the many exclusive features of Galion products.

#### Warco Road Building Exhibit

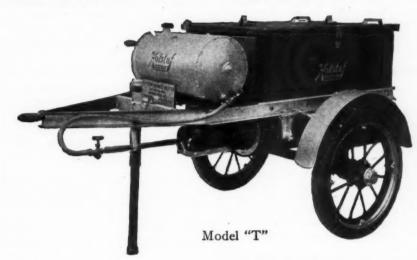
In space No. 155, the W. A. Riddell Company, pioneer manufacturers of power graders, will exhibit their complete line of Road Machinery. Among the machines included will be the improved Model "E," the "ER," the Model "10R" Road Hog and the Model "15" Road Hog.



Jaeger Skip Scale

# Hotstuf

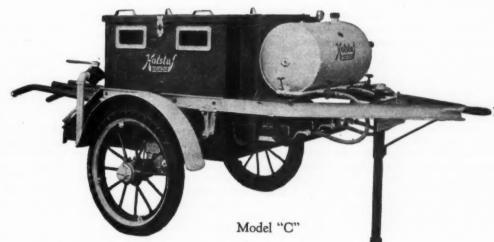
# EQUIPMENT FOR THE PROGRESSIVE ROAD CONTRACTOR

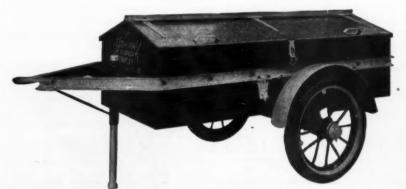


"HOTSTUF" ASPHALT HEATER, with the patented elevated melting chamber is sold on its greater melting capacity rather than storage capacity.

Made in capacities best suited for the Highway Contractor, City, County and State Highway Departments. Equipped with the MOHAWK torch having the patented removable coil feature.

"HOTSTUF" COM-BINATION TOOL AND ASPHALT HEATER has proven its economy among the sheet asphalt, street and road Contractors. Hot tools in five minutes and hot asphalt in ten minutes after lighting the MOHAWK burner, which has the patented removable coil feature.





MOHAWK HI-SPEED TRAIL-ER TOOL BOX. No more loss of tools by theft. Take them to the job, keep them there till the job is finished. Lock them up at night in a MOHAWK HI-SPEED TRAILER TOOL BOX, which is designed to fit the requirements of the up-to-date road contractor.

Mohawk Asphalt Heater Co.

**SCHENECTADY** 

**NEW YORK** 

VISIT OUR BOOTH NO. 510 AT THE ROAD SHOW

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These machines will be equipped with rubber tired wheels, Warco "TG" rear type crawlers; with independent scarifier, snow plow and bulldozer attachments. Warco "TH" crawlers will be shown mounted on McCormick-Deering tractors. The Warco Model "A," one yard scoop will be featured as a moving exhibit. The new Model "T," two yard Warco wheeled scoop will also be shown.

Another feature of the Warco display will be a new drawn or pull type grader. This machine has many new and unusual features, but details will not be forthcoming until the Show opens.

The exhibit will be in charge of N. E. Jersey, Manager of Road Machinery Sales. A number of Warco salesmen and many distributors will also be present.

### C. S. Johnson Co. Exhibit

The Johnson exhibit at the Road Show will consist of a full sized latest type demountable bin with scale batchers attached. Nothing is left for the contractor to provide for with this new Johnson plant. Even the smallest detail has not been overlooked. Foundation mats are provided. Operating platform is furnished. Hoist chains to be used in erecting are furnished. More steel has been added. Steeper sloping sides have been added to prevent hang-up of materials. A wider range in sizes will also be offered. These are only a few of the improvements made in the new Johnson demountable bins.

Johnson single material scale batchers will be attached to the bin. The scales are of beam type with beam balance indicator for showing balance, over or under load. Improvements have been made which will make the Johnson Scale Batchers even more efficient than ever.

Eastern contractors will have the opportunity of seeing at first hand the complete Johnson demountable plant, which is used so extensively in other parts of the country.

The Johnson Company will have in attendance at their booth engineers with complete data on batching plants, ready mixed concrete plants, central mixing plants and material yard installations.

### Link-Belt Exhibit

Link-Belt Company of Chicago, will exhibit their 1-yard capacity, type K-30, Gasoline Shovel at the annual convention of the American Road Builders Association. Their exhibit will be in space No. 321, Section C, on the main floor of the new Atlantic City Convention Hall, Atlantic City, N. J., January 11-17, 1930.

G. H. Olson, A. Eilersgaard, N. A. Weston and others from the Link-Belt organization will be in attendance. Link-Belt Crane agents from all parts of the country will also attend.

### Foote Bros. Gear & Machine Co.

Foote Bros. Gear & Machine Co., 111 N. Canal Street, Chicago, will have a very complete exhibit at the Atlantic City Road Show of their lines of road machinery including all latest models of the "Bates Steel Mule" tractors and Stockland road graders.

Many improvements in design and construction recently worked out on both the tractor and grader lines will be demonstrated in the exhibit models and should prove of considerable interest to any highway engineer, contractor or consumer.

The display will occupy over 2,000 square feet of floor space and a staff of engineers will be on hand to explain the design features of the various models and their application to specific problems in the road building field.

Three models of the "Bates Steel Mule Tractors" will be exhibited, the "30," "40" and "80," each powered by the Bates Waukesha motors. Many recent improvements in design and construction are incorporated in the new models including improved, easily accessible transmission with special bearing mountings—the Bates one piece hardened, track shoe, improved crawler frame, truck wheel construction, etc.

The Stockland exhibit will include representative types of its many models.

The Stockland 20 horse drawn patrol, popular with townships, will be

The Stockland "30," a year around maintenance machine for horses or light tractors.

The Stockland "40," a popular mod-

el for reconstruction and maintenance, is easily convertible from a two-man to a one-man outfit.

The Stockland "35-8," suitable for almost any kind of road work, is generally used with tractors of 30 to 35-horse power.

Stockland Models "50-10" and "80-12," the road graders for the heaviest road construction. The "80-12" is the largest road builder of the Stockland line, while the "50-10" handles all but the very heaviest construction work.

The No. 2 Whippet, the pioneer, pull type, one-man motor patrol, especially adapted for hard maintenance and reconstruction work. It has the capacities of a two-man grader and is for tractor of 20 to 30-horse power. The No. 1 Whippet is used with tractors of 10 to 20-horse power and is excellent in fast ditch maintenance.

### Heltzel Steel Form & Iron Company

In addition to the regular Heltzel Trailer Weighing Agrabatcher Plant, Heltzel will this year exhibit a similar unit for the handling and batching of bulk cement by weight. Through a novel arrangement they have produced a dustless cement storage bin, to which is attached the new Heltzel Cement Weighing Agrabatcher, which is equipped with the dial scale and assures absolute accuracy in the proportioning of cement for any required mix. The flow of cement is controlled by valves, and all the dust is taken directly back into the hopper, which is equipped with an air tight cover.

The standard line of Heltzel Steel Form Equipment will be displayed, and many additional features have been added to the various types of these Forms. The Form Exhibit will include Heltzel Armor Plate Steel Road Forms, all types of Curb-and-Gutter Forms, together with Forms for constructing sidewalks, and Straight and Battered Curb.

The Heltzel Steel Form and Bin Equipment will constitute the major portion of the exhibit, but there will be several other pieces of small equipment which will be of interest to engineers and road builders.



Johnson equipment to be shown at the Road Show

